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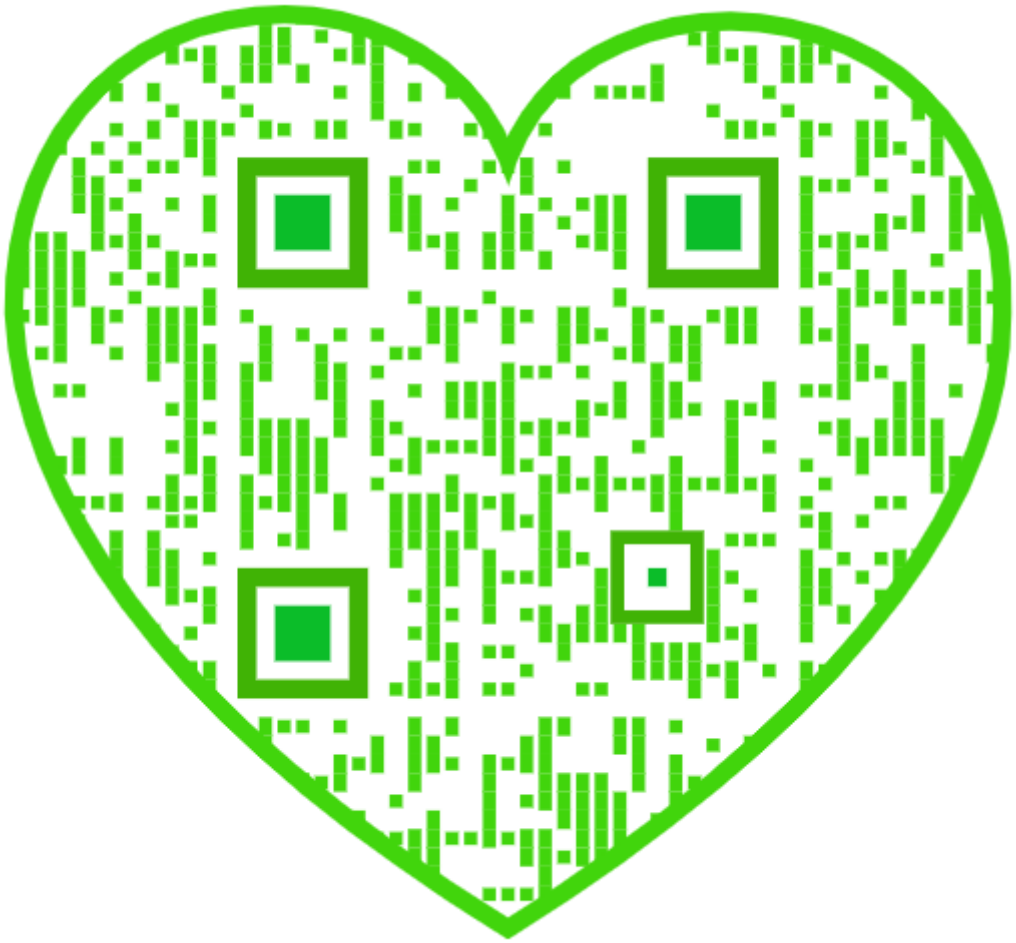

E. Sterling

A

MANUAL OF ETHERIZATION:

CONTAINING DIRECTIONS FOR THE EMPLOYMENT OF

ETHER, CHLOROFORM, AND OTHER ANÆSTHETIC AGENTS,

BY INHALATION,

IN

SURGICAL OPERATIONS,

INTENDED FOR MILITARY AND NAVAL SURGEONS, AND ALL WHO MAY BE EXPOSED TO SURGICAL OPERATIONS; WITH INSTRUCTIONS FOR THE PREPARATION OF ETHER AND CHLOROFORM, AND FOR TESTING THEM FOR IMPURITIES.

COMPRISING, ALSO,

A BRIEF HISTORY OF THE DISCOVERY OF ANÆSTHESIA.

BY CHAS. T. JACKSON, M. D., F. G. S. F.,

Chevalier de la Légion d' Honneur; Caviliere dell Ordine dei S. S. Maurizio é Lazzaro; Ritter des Rothen Adler; Knight of the Turkish Order of the Medjidieh; Member of numerous Scientific and Medical Societies in Europe and America.

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BOSTON:

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39 Court Street.

1861.

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Entered according to Act of Congress, in the year 1861, by
CHARLES T. JACKSON, M. D.,
in the Clerk's Office of the District Court for the District of Massachusetts.

TO THE READER.

This little book has been written with a view to interest both the Surgeon and the Soldier, and with the intention of aiding the one and of informing the other, as to the nature, effects, and management of Anæsthetic agents. It would have been easy to have multiplied cases without number, but it is thought that a few of the most authentic and accurately reported ones from the highest medical authorities, would suffice, and I am indebted chiefly to the most eminent French surgeons for the cases here translated and reported. It is not intended to place a small work, like this, in competition with more extended and elaborate treatises by others, but rather to fill up a space which no one has thus far occupied. It is hoped that the soldier in his camp will read with satisfaction the history of a discovery, which will in time of need prevent his suffering, when under the surgeon's knife; and no higher gratification would be desired by the author, than to know that he has made, what would otherwise have been a bed of suffering, one of pleasant dreams and happy thoughts, far removed from the horrors of the hospital. I would state that every allegation in this book is sustained by ample published evidence that has never been impeached in any quarter.

Charles T. Jackson.

TO

M. L. ÉLIE DE BEAUMONT,

Perpetual Secretary of the Imperial Academy of Sciences,

AND

MEMBER OF THE SENATE OF FRANCE,

THIS WORK IS MOST RESPECTFULLY INSCRIBED AND DEDICATED BY THE

AUTHOR.

EUROPEAN OPINION ON ETHERIZATION.

L' année 1846 sera célébre dans l'histoire des sciences: elle a vu éclore des résultats, des inventions ou des découvertes d'application qui honorent l'esprit humain, élargissent le champ de l'industrie ou atténuent les maux de notre espèce. Un nouveau corps céleste, déterminé par la seule puissance du calcul, le coton azotique, enfin un agent efficace contre la douleur liée aux opérations chirurgicales, voilà assurément un magnifique tribut apporté par la science. Les deux mondes ont eu leur part de gloire; mais, si nous avions à la peser nous n'hésiterions pas à couronner la conquête faité dans la patrie de Franklin et de Jackson. Si la découverte astronomique se distingue par la grandeur des difficultés vaincues, la découverte médicale brille par le nombre et l'utilité des services qu'elle a rendus. La première a fait éclater les ovations de l'Académie, les encouragements et les récompenses des souverains; la seconde a été surtout appréciée et bénie par les hommes malheureux et souffrants. Leverrier a glorifié l'humanité, Jackson l'a servie.—*Traité Théorique et Pratique de la Méthode Anesthésique Appliquée a la Chirurgie, par E. F. Bouisson; page* 3. *Paris,* 1850.

TRANSLATION.

The year 1846 will be celebrated in the history of the sciences. It has seen unfolded the results of inventions, or of discoveries of application, which do honor to the human mind, enlarge the field of industry, or diminish the sufferings of our species. A new celestial body determined by the sole power of the Calculus, the Gun Cotton, and at last an efficacious agent against pain in Surgical Opera-

tions, behold assuredly a magnificent tribute brought by science. The two worlds have had their share of glory; but if we had them to weigh we should not hesitate to crown the conquest made in the country of Franklin and Jackson. If the astronomical discovery is distinguished by the greatness of the difficulties conquered, the medical discovery excels, owing to the number and utility of the services which it has rendered. The first has caused an outburst of ovations from the Academy, the encouragements and recompenses of sovereigns; the second has been above all appreciated and blessed by unfortunate and suffering men. Leverrier has glorified humanity, Jackson has served it.

Non, nous le répétons bien haut: la nouvelle propriété que M. Jackson a la révélée au monde savant, n'a plus rien à craindre de ses ennemis; l'éther demeurera comme l'agent héroïque le plus précieux contre la douleur, et, à ce titre, un des plus éminemment utiles à l'humanité.—*Appréciation de Cette Découverte, par F. et D. A. Médecins, page* 18. *Paris,* 1847.

TRANSLATION.

No, we repeat it aloud; the new property which Mr. Jackson has revealed to the scientific world, has nothing more to fear from its enemies; Ether will remain as a most precious heroic agent against pain, and one of the most eminently useful to humanity.

CHAPTER I.

LA DOULEUR TUE COMME L'HEMORRHAGIE.

Dupuytren Leçons Orales.

Pain kills like hæmorrhagia, namely, by exhaustion of the powers of life, said the great Surgeon of the Hotel Dieu of France.

"Pain is an irregular and dangerous exaltation of sensibility. When connected with surgical operations it is a complication the more dangerous, because it is not confined to merely troubling the operation, but its influence extends beyond it and continues to disturb the organism." —*Bouisson*, page 8th.

"Ordinarily patients can support pain within certain limits. In cases where no unfortunate predispositions exist of exaggerated physiological sensibility or a great preoccupation of the mind, the common operations, such as amputations and the removal of tumors do not produce special accidents subordinate to the influence of pain, if the surgical operation does not extend over ten minutes or a quarter of an hour. Larger operations can be supported without danger necessarily accompanying them. But a painful operation which requires half an hour is full of real dangers. If it extends for a longer time the danger is no longer doubtful, and I have heard Delpech affirm that a surgical operation extended through three quarters of an hour exposed the patient to the risk of probable death."— Pages 16, 17, *Bouisson.*

"An operation exceedingly painful, if continued with-

out intermission for some time, will cause death by exhaustion of the nervous powers. Of this we have numerous instances."—Page 35, *Bouisson.*

Whatever removes the exhausting pains arising from the dread shock of the surgeon's knife adds greatly to the chances of the patient's recovery. Strongly impressed with this belief, for many years I sought for some method of preventing the pain of a surgical operation, looking over all the methods proposed by physicians, surgeons and chemists who had preceded me in the profession, without finding that any one had arrived at this desirable result.

It is unnecessary to refer to the attempts of the ancients to find some such method, since we know they all failed to discover any effectual means of preventing the sensation of pain in a surgical operation, but we must at least credit them with the earnest desire they have expressed that such a discovery should be made. We pass over the mythical accounts of the virtues of stones steeped in wine and vinegar, of the mandrake and other plants to which ancient historians attributed properties we know they do not possess.—[See Exposition et Histoire des Principales découvertes Scientifique Modernes par Louis Figuier, tome premiere. Paris, 1851; p. 177, et seq.

Opium had been employed in very high and even dangerous doses, on persons who were submitted to grave surgical operations; but although this drug rendered the subject sleepy and stupid, it did not reach the extent desired, of temporarily paralyzing the nerves of sensation, but acted more on those of organic life. Hence opium, and opiates generally, were found to act unfavorably on the patient, and to retard his recovery, while they proved of little benefit during the actual operation. Hyoscyamus, Conium, Belladonna, Indian Hemp, and other narcotic sedatives have proved equally unavailing in surgery, from causes referred to above. Severe cold, approaching to

freezing, as observed by Barron Larry after the battle of Eylau, when he operated on his half-frozen, wounded soldiers, acts as a local anæsthetic by benumbing the parts; but this method has its dangers, well known to surgeons, and is rarely employed. Gangrene is apt to supervene when limbs are thus partially frozen, and the exposure to cold is liable to bring on pneumonia, and other inflammatory complaints; hence a modern surgeon would not have recourse to freezing, so long as he has better methods at hand.

Drunkenness from alcoholic drinks has proved in many instances capable of wholly preventing the sensation of pain during surgical operations, both in the reduction of dislocated joints, and in amputations and other operations with the knife. Haller has reported instances of childbirth in the drunken state, in which not the least pain was felt, and Blandin at the Hotel Dieu amputated the thigh of a man who was brought in dead drunk, and the patient was entirely insensible to pain during the operation, and when his drunkenness passed off he was greatly surprised and grieved at the loss of his limb. Dr. George Hayward, one of the late surgeons of the Massachusetts General Hospital, informs me that several years before the discovery of Etherization, he amputated the leg of a man who was brought into the Hospital dead drunk, and that he did not manifest the slightest sensation of pain during the operation.

Richerand advises, when difficult luxations are to be overcome, and the muscular resistance is great, to make the subject drunk, and while he is in this state of muscular relaxation to reduce the dislocated limb. It seems now very remarkable, when it was so well known to surgeons and medical men generally, that drunkenness would produce such results, and that inhalation of ether vapor would quickly bring on intoxication, if etherization is nothing

more than drunkenness of short duration, that they had not conceived of the application of this method. It was probably never thought of by any one, before I made the trial of ether vapor on my own person; and thus discovered that the peculiar operation of this agent is effectual in the prevention of sensation of pain, and that when mingled with air ether vapor may be safely inhaled, so as to bring about total insensibility in the nerves of sensation. The history of these experiments will be given hereafter. I merely allude to the subject now, to compare the effects of alcohol and ether, the physiological action of which, as I shall show, is very analogous, so far as concerns their chemical action on the blood, and their own decomposition in the circulation. Drunkenness from spirituous drinks, in practical surgery is not desirable, and it has, in the experiments by M. Longet, rendered the patient unmanageable. It has also been found to act unfavorably on the recovery of the patient, since the drunken state disorders the digestive apparatus and greatly congests the blood-vessels of the brain. This method has therefore been laid aside as both immoral and unsafe. From experiments made by M. Serres, it appears that when a nerve is laid bare and wet with ether it loses its sensibility. This would seem to indicate that absorbed ether acts directly, by contact with the nerves, when it is administered by inhalation, and is thus taken into the circulation.—*Compte Rendu* for 1847, p. 162.

Mesmerism, according to trustworthy evidence, has in a few instances proved efficacious in the prevention of pain in surgical operations. We refer to the case reported by Cloquét, and to those by Dr. L. A. Dugas, of Augusta, Ga. (See Southern Medical and Surgical Journal for 1845, pp. 122, 508, and for 1846, p. 72.)

The objections which surgeons make to placing any reliance on this mysterious agency is, that there are very

few persons who are capable of being put into the mesmeric state, even when not alarmed by the apprehension that a grave surgical operation is about to be performed upon them, and even facile subjects may be so agitated as to prevent any effectual influence being exerted upon them; therefore this power, whatever it may be, is not generally available. Trials made in the Massachusetts General Hospital many years ago, when mesmerism was more in vogue than now, all proved to be failures. Cloquét's case, which has been so extensively quoted in works on mesmerism, and which I have myself heard him relate in his lectures, is certainly a wonderful one, as are those published by Dr. Dugas, and show how the control of the nerves, even by this incomprehensible agency, may prevent all sensation of pain. Protoxide of Nitrogen, or exhilarating gas, has been supposed by some persons to be an Anæsthetic agent. In the year 1800 a work appeared, entitled, "Researches, Chemical and Philosophical, chiefly concerning Nitrous Oxide or Dephlogisticated Nitrous Air and its Respiration, by Humphrey Davy, Superintendent of the Medical Pneumatic Institution, London." In this book Davy gives an account of his experiments on the effects of inhalation of protoxide of nitrogen, and says of one of his experiments, while suffering from the pain attendant upon cutting of a wisdom tooth, "On the day when the inflammation was most troublesome I breathed three large doses of nitrous oxide. The pain always diminished after the first four or five inspirations; the thrilling came on as usual, and uneasiness was for a few moments swallowed up in pleasure. As the former state of the mind returned, the state of the organ returned with it; and I once imagined that the pain was more severe after the experiment than before." (Page 465.)

Again, on page 464 he says, after breathing the nitrous oxide, "I imagined that I had increased sensibility of

touch: my fingers were pained by anything rough, and the tooth edge was produced from slighter causes than usual. I was certainly more irritable, and felt more acutely from trifling circumstances."

This increased irritability, produced by inhalation of protoxide of nitrogen, is confirmed by Dr. Beddoes, the employer of Davy, on page 543 of the work above named. He says, "Several times I have found that a cut, which had ceased to be painful, has smarted afresh, and on taking two doses in succession, the smarting ceased in the interval, and returned during the second respiration."

Thus it appears from the researches of the discoverer of Protoxide of Nitrogen himself, and from the experience of his medical instructor and employer, Dr. Beddoes, that Protoxide of Nitrogen, or exhilarating gas, has no anæsthetic properties; and the reader will please to observe, that the researches and experiments above quoted had directly for their object the discovery of some means of rendering the body free from pain, for Davy had thrown out the suggestion that some "slight surgical operations, in which there was no great effusion of blood," might be rendered painless through the effects of this gas. Here, then, we have a full refutation, by himself and his master, of that rather too hasty statement.

Yet, strange as it may appear, there are persons—yes, even scientific and medical gentlemen, both in this country and in England—who claim the scientific discovery of Anæsthesia for Davy! We cheerfully give Davy the credit of searching for some means of preventing the sensation of pain, a credit he must share with many others who lived centuries before him, but neither he nor they found any such remedy.

I have in former publications stated, as I do now, that my attention was first awakened to this subject while a student of medicine, by reading Davy's researches; but

from the above quoted passages it will appear that I found no method of producing insensibility to pain in that book.

By oft repeated experiments, inhaling Protoxide of Nitrogen myself, and by administering it to others in every possible way, by large and small orifices, I soon became fully satisfied that it possessed no Anæsthetic properties. Horace Wells, a dentist of Hartford, Conn., repeated Davy's experiments in Boston in 1844, extracting teeth from persons to whom he had administered Protoxide of Nitrogen. I did not witness his experiments, but understood from others that he failed to render his subjects insensible to pain. In 1847 he met with a similar failure in the hospitals of New York, thus fully sustaining the conclusions of Davy, that this gas will not prevent the sensation of pain.

In the experiments with Protoxide of Nitrogen, made under the direction of Hon. Trueman Smith, at Washington, the subject was rendered unconscious by Asphyxia, the opening through the stopcock of the gas bag being only of the size of a knitting needle. In my experiments I obtained a similar result, particularly in the case of Henry Sumner, Esq., whom I operated upon in 1838 with this gas. His face showed the lividity of partial Asphyxia, but still he was sensible to pain as was proved by pulling his hair.

In my communications to the Boston Society of Natural History many years since, I proved that the effects of Protoxide of Nitrogen and of Ether were directly opposite in their character and nature, and that the free administration of that gas brings on the wildest excitement, while Ether administered freely produces a sedative influence and somnolent state, and that by administration of Protoxide of Nitrogen by a small aperture in the stopcock, no excitement is produced, but a still and partially asphyxiated state is brought on in the patient, in which sensation is not destroyed or diminished perceptibly; also, that by

administration of Ether in smaller proportions, a state of excitement only is brought on.

In 1828 Mr. Hickman, an English surgeon, presented to the Academy of Medicine of France, through the chamberlain of King Charles X., a letter in which he alleges that he had discovered a means of rendering animals insensible to pain. His method was to drown them with Carbonic Acid gas, and to operate during the unconscious state, and he wished to have the experiment tried on man. This the Academy would not sanction, regarding the experiment as exceedingly hazardous to life. Nothing was done about it, and yet we have seen that a Society of English students and dentists, styled "the Parisian Medical Society," set up a claim to the merit of discovery of Anæsthesia in favor of Mr. Hickman, on the ground that he proposed "a method by inhalation of a gas." This method deserves no more attention than that proposed by Morgagni, namely, the compression of the jugular veins, so as to bring on a torpor of the brain, by sanguineous congestion with venous blood, a method by no means free from danger, and one that is wholly impracticable in a surgical operation of any considerable duration.

We may therefore summarily dismiss the fabulous means proposed by the ancients for the prevention of pain in surgical operations, and likewise all those doubtful methods which preceded the use of Ether by inhalation, since experience has shown them to be inefficacious or unreliable.

CHAPTER II.

APPROACH TO AND FINAL DISCOVERY OF ANÆSTHESIA.

The Discovery intrusted to Scientific Friends.

Discouraged by the want of favorable results from my experiments with protoxide of nitrogen, which I administered in every conceivable manner, I did not wholly abandon the idea of ultimately finding something that would produce the effect which I was in search of; and it seemed strange, after I had made the discovery of the anæsthetic properties of ether vapor, that I had not sooner thought of employing it for that purpose; but it often happens that the thing we were searching for was all the time close to us, and we had overlooked it.

This seems more remarkable to me, because I was familiar with the fact that stupor had been in several instances produced by inhalation of ether vapor; but that was regarded at the time, by all who reported the cases, as an exceedingly dangerous state. Orfila, Brande's Journal, Pereira, Christerson, and other high toxicological authorities had classed ether among the narcotic poisons, and had given instances of death from its inhalation in support of their opinions. The case of "the gentleman who was thrown into a state of dangerous stupor of thirty hours' duration, in which his life was considered in imminent danger," has repeatedly been referred to by writers since I made my discovery known to the public. This was certainly not a case to suggest to me, as some have imagined it might have done, that ether would produce a state of

insensibility to pain, and could be safely employed for that purpose.

Even the more marked cases of stupor, from inhalation of ether vapor, noticed by my friend Mr. John H. Blake, at the Norfolk Laboratory, only proved that persons so affected recovered readily when exposed to a current of fresh air. This fact served to corroborate my opinion as to the safety of etherial inhalation. No one imagined that they were insensible to pain while in that state of stupor, and, as Mr. Blake deposes, he had not conceived of the idea.

I was not only aware of Mr. Blake's cases, but knew also that college boys and factory girls had inhaled ether with the utmost freedom, without any ill effects upon their health. I knew also, by my own experience in the use of ether vapor as an antidote to chlorine, that it could be breathed, when mingled with air, without the least danger. Hence I was in a position to make the discovery, and did soon after make it, as stated in the following pages, and placed it in other hands for practical trial, under my directions, with a view to obtain the illustrations I needed before making the matter public.

In the year 1837 I discovered that ether vapor was superior to that of alcohol as a remedy for the strangling and toxical effects resulting from inhalation of chlorine gas, and it was used for that purpose in my laboratory from that time forth; and one of the most remarkable cases in which I employed it was that of the late Henry Sumner, Esq., who was most severely affected by chlorine gas while working in my laboratory as my pupil. This discovery I made known at the time to most of the chemists with whom I was acquainted, and it was adopted extensively.

Familiarity with the influence of ether vapor prepared me for the discovery of its anæsthetic effects, and I men-

tion the above facts in order to show how gradually this discovery was approached, but still not realized until I made those capital experiments on my own person, which, according to the highest scientific authorities, established my rights as the first discoverer and verifier of anæsthesia.

M. Roux, in behalf of the Commission of the French Academy of Sciences declares that Dr. Jackson first discovered the effects of ether vapor, the physiological fact of anæsthesia, and verified it by experiments on himself. These are the words:

"M. Jackson avait remarqué que quelques individus, pour être restés pendant un certain temps exposés à l'action de vapeurs éthérées, avaient été momentanément privés de tout sensibilité. C'est le fait physiologique, M. Jackson l'a vérifié sur lui-même."—*Compte Rendu*, Mar. 4, 1850, p. 243.

HISTORY OF THE ORIGIN OF THE ETHER DISCOVERY.

The following extract from a letter addressed by the author to the venerable Alexandre Von Humboldt in 1851, contains a condensed history of the origin of the discovery of etherization.

Baron Von Humboldt, by orders of the King of Prussia, applied to the State Department of the United States when Hon. Daniel Webster was Secretary, for copies of all the evidence of the American claimants of the discovery of anæsthesia by ether, and he was duly furnished, I suppose, with all the documents required. His instructions from the king were to investigate the facts, and to inform him of the result of his examination.

From time to time I heard that the baron was deeply engaged in his investigations, and that he was "overwhelmed with documents from various quarters." At length the result was arrived at, and King Frederic William, sent me the order of the Red Eagle of Prussia, as a testimonial of his satisfaction, and a recognition of my

rights to the discovery of anæsthesia. This was received in 1857, through the Prussian minister at Washington, the Baron Von Gerolt.

This voluntary and independent examination of the question of discovery, was undertaken on account of a continuance of the controversy, at Washington, before Congress, after the regular award had been made by our umpire, the French Academy of Sciences. The result is of course quite satisfactory to me, and the opinion of such a man as Humboldt, when he had an opportunity to examine the evidence, cannot fail to be accepted by all men of science.

"The circumstances were as follows. In the winter of 1841–2 I was employed in giving a few lectures before the Mechanics' Charitable Association in Boston, and in my last lecture, which I think was in the month of February, I had occasion to show a number of experiments in illustration of the theory of volcanic eruptions, and for these experiments I prepared a large quantity of chlorine gas, collecting it in gallon glass jars over boiling water. Just as one of these large jars was filled with pure chlorine, it overturned and broke, and in my endeavors to save the vessel, I accidentally got my lungs full of chlorine gas, which nearly suffocated me, so that my life was in imminent danger. I immediately had ether and ammonia brought, and alternately inhaled them with great relief.

"The next morning my throat was severely inflamed, and very painful, and I perceived a distinct flavor of chlorine in my breath, and my lungs were still much oppressed.

"I determined therefore to make a more thorough trial of ether vapor, and for that purpose went into my laboratory, which adjoins my house in Somerset Street, and made the experiment from which the discovery of anæsthesia was deduced. I had a large supply of perfectly pure washed sulphuric ether (oxide of ethyle), which was pre-

pared in the laboratory of my friend Mr. John H. Blake, of Boston. I took a bottle of that ether and a folded towel, and having seated myself in a rocking-chair, placed my feet in another chair so as to secure a fixed position as I reclined in the one in which I was seated. Soaking my towel in ether I placed it over my nose and mouth, so as to allow me to inhale the ether vapor mingled with air, and began to inhale the vapor deeply into my lungs. At first it made me cough, but soon that irritability ceased, and I noticed a sense of coolness followed by warmth, fullness of the head and chest, with giddiness and exhilaration, numbness of the feet and legs, followed by a swimming sensation as if afloat in the air. This was accompanied with entire loss of feeling, even of contact with my chair. I noticed that all sensation of pain had ceased in my throat, and the sensations which I had were of the most agreeable kind. Much pleased and excited I continued the inhalation of the ether vapor, and soon fell into a dreamy state, and then became unconscious of all surrounding things. I know not how long I remained in that state, but suppose that it could not have been less than a quarter of a hour, judging from the degree of dryness of the cloth which during the stage of unconsciousness had fallen from my mouth and nose, and lay upon my chest.

"As I became conscious, I observed that there was no feeling of pain in my throat, and my limbs were still deeply benumbed, as if the nerves of sensation were fully paralyzed. A strange thrilling now began to be felt along the spine, but it was not in any way disagreeable. Little by little sensation began to manifest itself, first in the throat and body, and gradually it extended to the extremities; but it was some time before full sensation returned and my throat became really painful.

"Reflecting on these phenomena, the idea flashed into my mind that I had made the discovery I had for so long a

time been in quest of—a means of rendering the nerves of sensation temporarily insensible, so as to admit of the performance of a surgical operation on an individual without his suffering pain therefrom.

"That I did draw this inference, and did fully declare my unqualified belief both of the safety and efficiency of this method of destroying all sensation of pain in the human body during the most severe surgical operations no one doubts, and it is fully proved by abundant legal evidence, which has never been impeached or doubted in any quarter.

"I beg leave to refer you again to the evidence of Dr. William F. Channing, a man of science, Fellow of the American Academy of Arts and Sciences, son of the late Dr. William E. Channing, our most eminent divine; to the testimony of Dr. S. A. Bemis, one of our most eminent dentists; to the letter of John H. Blake, Esq., a distinguished chemist, and to the testimony of Mr. Henry D. Fowle, one of our best and most faithful apothecaries. Their evidence, with that of my worthy friend and former pupil, Mr. Joseph Peabody, élève ingenieur à l'Ecole des Mines de France, prove that I had made this discovery long before any other person had ever tried a single experiment of the kind.

"In the rapid operations of the mind, it is not always easy to trace (in memory) the exact method of thought by which we suddenly arrive at great truths; but so far as I can trace the reasoning that rapidly flowed through my mind, it was based upon principles well understood by all educated physicians and physiologists.

"I knew that the nerves of sensation were distinct from those of motion, and of organic life, and that one system might be paralyzed without necessarily and immediately affecting the others. I had seen often enough, in my medical practice, the nerves of sensation paralyzed without

affecting those of motion, and those of motion paralyzed without affecting those of sensation, and both motion and sensation paralyzed without affecting the ganglionic nerves or those of organic life.

"I knew, also, that the nerves of sensation are stationed as sentinels near the exterior of our bodies, to warn us of danger from external causes of injury, and that there is no feeling in the internal portions of our bodies. I knew, also, that when the knife is applied in surgical operations, that there is little sense of pain in any parts beneath the skin (the trunks of nerves only excepted.) This my own surgical experience, as well as that of others long since demonstrated, and the philosophy of those physiological phenomena was made known to the medical world by Charles Bell, Majendie, and other eminent anatomists and physiologists in Europe.

RESUMÉ.

"Now I had observed that the nerves of sensation in my own body were rendered *insensible to feeling* for some time before unconsciousness took place, and that this insensibility continued after consciousness had returned, and I was fully able to observe the facts.

"2d, That all pain had ceased in a suffering part of my body during the stages of etherization preceding and following the unconscious state.

"3d, That the state of insensibility of the nerves of sensation continued for a sufficient length of time to admit of most surgical operations, and I had reason to believe that, during the unconscious period, the degree of insensibility was still greater, so that it would be impossible that any pain could be felt from a surgical operation.

"4th, That the nerves of motion and of the involuntary functions of respiration and of circulation were in no wise affected, the functions of life going on as usual, while the

nerves of sensation were rendered devoid of feeling, and the body therefore could suffer no pain.

"By long experience in the trial of ether vapor in spasmodic asthma, and from numerous carefully conducted physiological experiments, I had learned that ether vapor could be safely inhaled into the lungs, and to an extent before believed to be highly dangerous. (See Orfila, Brande's Journal, Peirera Materia Medica, &c.)

"That I did first discover that the nerves of sensation could be and were paralyzed to all sensation temporarily and safely, by the inhalation of ether vapor, is admitted by all scientific men who have examined the evidence.

"That I did first prescribe its administration, for the purpose of preventing all sensation of pain in surgical operations, with the guarantee on my medical and scientific responsibility of its entire safety, provided my directions were strictly obeyed, and did thus introduce the use of pure sulphuric ether vapor mixed with air into surgical practice, is fully proved by abundant testimony, and this is admitted by all persons who have examined the evidence that I have caused to be published. The few who have opposed my claims are either ignorant of the facts proved, or they wilfully ignore evidence that they cannot dispute."

Those most competent to judge in this case have long since decided that I discovered the principle of anæsthesia, verified it by experiments on my own person, and by my prescription, also, made the application of it to surgery, in the highest sense of that term. (See Statement by Dr. Martin Gay, and Report of the Commission of the Academy of Sciences of France; also, Whewell's Novum Organon.) I communicated this discovery to the gentlemen below named.

1. In the winter of 1841–2, to George Darricott, Esq., engineer.

2. In the spring of 1842, to John H. Blake, Esq., chemist.

3. In the summer of 1842, and also in the winter of 1846, I prescribed and administered it to Dr. William F. Channing, chemist.

4. In 1842, to Francis Alger, Esq., mineralogist.

5. In the spring of 1842, to Dr. Augustus A. Gould, physician.

6. Sept., 1842, to Dr. S. A. Bemis, dentist.

7. Oct. 5 and 6, 1842, to Dr. George T. Dexter, of Lancaster, N. H.

8. In 1842 or 1843, to Mr. Henry D. Fowle, apothecary.

9. Nov., 1845, to Mr. D. J. Browne, engineer.

10. Feb., 1847, to Mr. Joseph Peabody, chemist.

11. Sept. 30, 1846, to Mr. W. T. G. Morton, dentist.

12. Same date, to Mr. George O. Barnes, chemist.

13. Same date, to Mr. James McIntire, chemist.

14. Oct. 2, 1846, to Dr. David K. Hitchcock, dentist.

15. Oct., 1846, to Dr. John C. Warren, surgeon.

From the year 1842 to 1846 Dr. William F. Channing was an assistant in my laboratory, and during the winter of 1846, by the accidental inhalation of chlorine gas, came very near losing his life. I came in at the opportune moment, and at once administered ether vapor to him very freely so as to bring on entire temporary relief, though he suffered much for weeks afterwards from the violence of the inflammatory action brought on by the chlorine. He describes the pain from the effects of chlorine as being as severe as that from a surgeon's knife. (See his deposition; also the opinion of Dr. J. B. S. Jackson in the Boston Medical and Surgical Journal, and Dr. Gay's statement.)

I also persuaded my pupil, Mr. Joseph Peabody, to make use of ether vapor by inhalation for the purpose of preventing sensation of pain in the extraction of two teeth; but his father, fully acquainted with toxicological authorities,

prevented the experiment, showing his son Orfila's, Christerson's, and other toxicological books, to prove to him that ether was extremely dangerous to inhale. This appears both from Mr. Peabody's deposition and from Mr. Francis Peabody's letter to me.

While on the Geological Survey of the State of New Hampshire, Dr. Channing being with me at the time, I endeavored to persuade Dr. S. A. Bemis, a very eminent dentist, to employ etherial inhalation as a means of preventing all sensation of pain in the extraction of teeth, and I felt slighted by his not embracing my proposal at once. (See his deposition.)

While engaged in my labors as United States Geologist on Lake Superior, in 1847, '48 and '49, I had frequent opportunities for experimenting with ether and chloroform in small operations, especially among the Indians and miners, and in one case I rendered a stout Indian insensible to pain and unconscious for four hours, using a mixture of ether and chloroform. This was to convince the missionaries at l'Aunce station that a person could be kept in that condition long enough for any surgical operation. I had only to extract a tooth, however, in that case. When under the first effects of the anæsthetic agent, this Indian resisted me furiously; but I placed my arm around his neck and held on to him so closely that he could not escape nor injure me, and by keeping the sponge as much as possible over his nose and mouth in the struggle, he was soon subdued, and sank upon the earth wholly insensible. His pulse was reduced to thirty beats per minute, and he lay in a snoring sleep, from which his Indian brethren could not awake him, though told to do so. At such time as the rising of the pulse indicated the probability that he could be awakened, I dashed some water in his face and called upon him to awake, which he did immediately to the great astonishment of his aboriginal friends,

who thought him dead. They pronounced this "great medicine." I soon had so many calls upon me for petty surgical operations, under ether, that I was heartily rejoiced when I could truthfully say I had no more of it, and hence could not attend to their calls.

Si le véritable créateur et possesseur d'une vérité est celui qui non seulement la trouve en elle-même, mais qui sait aussi en voir et en faire adopter les conséquences, nul ne remplit mieux que M. Jackson les conditions à l'aide des quelles un économiste célèbre, M. J.-B. Say, prétend qu'on établit la propriété intellectuelle d'une vérité.—*Méthode Anesthésique, par E. F. Bouisson; Paris,* 1850; p. 58.

TRANSLATION.

If the real creator and possessor of a truth is he who not only finds it out in itself, but who knows also how to discern and cause to be adopted its consequences, no one has fulfilled better than Mr. Jackson the conditions, by means of which the celebrated economist, Mr. J. B. Say, maintains one establishes intellectual property in a truth.

Il est bien facile de voir que les nombreux compétiteurs de M. Jackson n'ont aucun droit à sa dècouverte, et que l'honneur lui en est réservé exclusivement.—*Effets Physiologiques et Thérapeutiques des Ethers, par H. Chambert, Docteur en Médecine de la Faculté de Paris; Paris,* 1848: p. 13.

TRANSLATION.

It is very easy to see that the numerous competitors of Mr. Jackson have no right to his discovery, and that the honor is reserved for him exclusively.

CHAPTER III.

ETHER.

Sulphuric Ether, or the Oxide of Ethyle, as it is now called, was known to the ancient chemists, and according to Berzelius, the first receipts for its preparation were published by Valerius Cordus, in 1540, who gave it the name of Oleum Vitrioli dulce. Basil, Valentine, and Paracelsus appear to have been acquainted with it, though not in its pure state.

Frobenius gave the name Ether to this volatile liquid.

It is prepared from a mixture of equal parts of alcohol, of specific gravity 0·830, and sulphuric acid of density 1·85 at 20 deg. Cent.

The alcohol is first introduced into the retort, and while moving it so as to make it gyrate in it, the sulphuric acid is added in a small stream, and mixed thoroughly with the alcohol. The retort is then adapted to a voluminous tubulated recipient, the tubulure going into a bottle, and the retort is placed in a sand bath and distillation is effected at a moderate heat. At first considerable unaltered alcohol distils over; but when the proper temperature is reached, ether commences to distil. Peculiar striæ appear in the neck of the retort, so long as ether is coming over; and when these cease the operation must be stopped. In this operation the sulphuric acid acts only by catalysis, and is not itself decomposed; and since sulphuric acid forms no part of the ether, it is obvious that the name sulphuric ether is improper.

The best method of preparing ether, consists in running the alcohol in a small stream into acid, properly heated to the temperature required for the production of ether. If the acid has a specific gravity of 1·85 the reaction would be too violent, and the ether would be transformed into olefiant gas. It is necessary, therefore, to dilute the acid with water, until it is brought to the density of 1·78; or, still better, we may dilute the acid with alcohol, by mixing three parts of acid with two parts of alcohol of eighty-three per cent. After distilling off part of the ether, which this mixture produces, alcohol is allowed to enter by a small tube, which opens below the level of the acid in the retort. This tube comes from a reservoir of alcohol, placed at a suitable level to give the supply, and has a stopcock to regulate the passage of the alcohol.

The distillation is effected at a temperature of 300 deg. Fahr., and this is regulated by observation of a thermometer, which plunges into the acid mixture. The distilling ether is condensed by means of one of Leibig's condensers, cooled by means of ice-water.

It is necessary to re-distil this ether from a solution of hydrate of potash, or soda, in order to remove any acid that may be mixed with it. Then it is to be mingled with its bulk of water, or, still better, with lime-water, and after thorough mixing by agitation, the lime-water may be drawn off from below and the washed ether separately obtained. This is then to be re-distilled from chloride of calcium, and is then pure rectified ether, suitable for inhalation. It should however first be tested as will be described further on, to ascertain that it is absolutely pure. Dr. Nichols, of Boston, is in the practice of rectifying his ether in vapor over dry lime, a process which is recommended, since it is sure to remove all traces of acid.

When ether is manufactured on a large scale, the retort consists of a large leaden vessel, which is placed in a bath

of chloride of calcium. The top of this vessel has a leaden cover hermetically sealed on it, and this is traversed by two tubes, one of which conveys the alcohol into the acid, and the other the vapor of ether through a condenser into the recipient. Both these tubes are made to pass through a wall, from another separate room, where the alcohol reservoir and the condensing apparatus with the recipients are placed. The opening in the wall should be closed tight around the tube, so that by no possibility can there be any communication of the ether vapor with the fire of the furnace, for fear that an explosion might take place.

It is also necessary to avoid introducing any flame into the condensing room at any time, and if a light is needed when operating during the night, a Davy safety lamp must be employed. Fearful accidents have followed from neglect of this precaution. In Mr. J. H. Blake's works, men would, despite his warning, enter the ether cells with a naked flame, and in one instance an explosion followed which threw the man out of the cell and to the distance of twenty feet from the door. The men employed in decanting the ether, if the room is not well ventilated, are sometimes fully etherized and rendered unconscious, and they have been taken from the cells in this state, as before stated, by Mr. Blake.

Ether of commerce is liable to contain many impurities, the most fatal of which is sulphurous acid, which comes from decomposition of the sulphuric acid, and is a constant product when ether is made by the old process. This acid is best removed by the action of hydrate of lime. Oil of wine is also another product, which is commonly present in ordinary ether, and sometimes fusel oils, or products of their decomposition, exist in it. Alcohol is always found in greater or less proportion in the ordinary ether of commerce, and since it operates very unfavorably on the

anæsthetic powers of the ether, it must always be carefully removed by adequate washing of the ether with water.

Gay Lussac advises to wash ether with twice its bulk of water, and then with pulverized lime, leaving the ether in contact with the lime for twelve or fourteen days, and then distilling off the ether, saving for use only one third of it,—that which comes over first,—the rest, being mixed with more or less alcohol, is put aside and added to a new lot of alcohol which is to be converted into ether.

Since there is a considerable loss of ether by washing when much alcohol is present, it has been found economical to re-distil the ether at a graduated heat by means of a hot water bath, so as to permit its separation from most of the alcohol, before washing it with water.

The heat should be eighty deg. Cent. for the first distillate, and when the temperature reaches from eighty-five to ninety deg. another lot may be saved, which will contain alcohol. This may be washed separately with lime-water, and then be re-distilled, or it may be added to the alcohol, which is about to be employed in the production of another portion of ether.

Pure ether is colorless, very fluid, and has a peculiar penetrating odor, and a taste at once burning, sweet and cool. It is neither acid nor alkaline, is a non-conductor of electricity, and refracts light strongly. Its specific gravity is 0·7155 at twenty deg. Cent., according to Sausseur. The tension of its vapor at eighteen deg. Cent. is equivalent to the support of half the barometric column sustained by the atmosphere. At thirty-five and sixty-six one hundredths deg. Cent. its vapor weighs 2·586, air being 1.

At minus thirty-one deg. C. ether crystalizes in brilliant white blades, and at forty-four deg. Cent. it forms a solid crystalline mass.

Its vapor takes fire when flame is approached near to it,

and it burns with a yellow flame, which deposits smoke on a cold body placed over it. With air or with oxygen, it forms an explosive mixture, which, on being inflamed, detonates violently. Ether vapor mixed with ten times its volume of oxygen gas, when exploded, absorbs six volumes of the oxygen, giving birth to four volumes of carbonic acid and water.

At 150 deg. Cent. ether undergoes a peculiar slow combustion, with the appearance of a pale blue flame, if it is dropped on a brick heated to that temperature. Aldehyde, an oxidated product, results.

Ether is soluble to a certain extent in water, nine parts of water dissolving one part of it. This solution has a density of 0·95, and at forty deg. Cent. it boils, and the ether separates or distils off.

On the other hand, ether also dissolves one thirty-sixth of its weight of water, so as to become hydrous; and if the removal of this water is desired, it can readily be accomplished by distilling the ether from chloride of calcium.

Ether absorbs ammonia readily. Potash, soda and lime, when brought in contact with ether, if aided by a moderate heat, convert it into acetic acid, which combines with the alkali or base.

Alcohol dissolves ether in all proportions, and can be separated from it by the action of water, if the proportion of ether is greater than one fifth its bulk; but if less than this, the proportion of water employed would also dissolve the ether; hence there is a considerable waste when we wash an ether that contains any considerable proportion of alcohol.

In contact with air ether alters little by little. It absorbs oxygen and is gradually converted into acetic acid and water. This acetic acid reacts on the ether, forming acetic ether. To prevent the oxidization of ether it should

be put in bottles entirely filled, and which should be well corked and kept in a cool place.

According to Berzelius ether is composed of

Carbon,	4 atoms	or per ct.	= 64·915
Hydrogen,	10 "	"	13·481
Oxygen,	1 "	"	21·604

Hence its symbol will be $C^4\ H^{10}\ O = Et\ O$

Et. being $C^4\ H^{10}$.

Alcohol has for its formula $C^4\ H^{12}\ O^2$.

The removal of one volume of oxygen and two of hydrogen, or one atom of the equivalents of water, reduces alcohol to ether. Berzelius adopts the view, that hydrogen being two volumes to oxygen, one volume in the composition of water, these proportions should represent their atomic relations. Others who take the double volume as one atom, would write the formula for ether, $C^4\ H^5\ O$. This formula is generally adopted here and in England. We should however state that the elements oxygen and hydrogen do not exist in the alcohol in the state of water, as may easily be proved by the fact that bodies having a strong attraction for water do not separate it from alcohol. Berzelius therefore regards alcohol as a peculiar and definite compound, and not as a hydrate of oxide of ethyle, as is imagined by Liebig and Dumas.

Ether boils at ninety-six or ninety-eight deg. Fahr., and it evaporates with great rapidity when exposed to the air, leaving nothing behind if it is pure. Owing to its rapid conversion into vapor it abstracts heat from bodies, so as to reduce their temperature to the freezing point and even below it. When burned, it produces carbonic acid and water only.

In washing ether, I make use of a separating bottle, arranged as follows:

a. Glass jar.

b. Air tube.

c. Tube for drawing off the water first, and then the ether.

d. Division line between the ether and the water.

A stopcock may be attached to the tube *c*, which may be made of metal.

Lime-water may be used instead of water, if the presence of any acid is suspected in the ether.

Into the bottle, right end up, pour the ether which is to be washed, then add the water or lime-water, shake up thoroughly for some minutes, holding the hand over the mouth of the jar. Then put in the cork with the tubes all arranged. Invert the jar, and let it remain until a distinct line of demarcation is seen between the ether and the water; then open the tube *c* and let the water flow out, which will run out tranquilly, since the air gains admission by the tube *b*. When the water has run out, stop the tube *c*, or bring it over the bottle into which you wish to decant the ether. It is now what is called hydrous ether, containing one thirty-sixth of its bulk of water dissolved in it. This is found to be advantageous when the ether is to be inhaled; but if it is intended to procure dry ether, then it must be distilled off from pulverized chloride of calcium, which will abstract all the water and the distilled ether will be pure.

It has been observed that hydrous ether does not irritate the respiratory passages so much as dry ether, and that the aqueous residue holds the impurities, which are smelt on a cloth or sponge that has been used in administration of the vapor.

When we wish to ascertain how much alcohol is contained in a sample of ether, it may be readily tested by

means of a graduated tube, which may be a test tube divided into equal measures and marked by means of a diamond or file. Twenty divisions will suffice.

Keeping in view the proportion of ether which water itself dissolves, namely, one tenth of its bulk, and of course not deducting that, by mixing equal bulks of ether and water, shaking them up, well corking the tube, and allowing the water and ether to separate, we can read off how much ether there is in the sample tested, and how much alcohol there was by difference.

By taking the specific gravity, in a bottle prepared for that purpose, we may also ascertain whether the ether contains alcohol or not. A thin phial, which will hold ten grammes of distilled water at sixty deg. when full and stopped, is a convenient vessel for taking the specific gravity of ether and other volatile liquids. This bottle has a counterpoise for it, when empty and perfectly dry. Fill it with ether and weigh it, and the specific gravity is known. In case a delicate balance is not at hand, the hydrometer for ether will give a close approximation to the specific gravity.

To test for acids, take blue litmus paper, and put a strip of it into the ether, and observe if it turns red. If so, the ether is acid. If the color is ultimately bleached out, then sulphurous acid is present. Allow a quantity of the ether, say an ounce, to evaporate spontaneously, and see if any acid remains. Test this residual matter with the litmus paper, then see if this acid is driven off by a boiling heat; if so, it is probably acetic acid. If it is not, but becomes stronger by evaporation of its water at that temperature, it is probably sulphuric acid. Test it with solution of chloride of barium; a white precipitate shows that it is sulphuric acid. On evaporation of a volatile acid, the odor will show whether it is acetic acid or not. Fusel oil is detected by adding half its bulk of strong

sulphuric acid to the ether, which will make it brown if that substance is present.

Aldehyde is detected by the action of a strong solution of caustic potash, which turns it brown from the precipitation of resin of aldehyde.

Take a small sheet of filtering paper, and wet it with ether, and allow it to evaporate. Smell of it from time to time as it dries, to ascertain if there is any matter which you can recognize by its odor, particularly sulphurous acid, aldehyde and fusel oil. Observe whether any odor remains on the paper, after the ether is all evaporated; if so, the ether was not pure. It is rare, however, to find any ether in commerce that does not leave some odorous matter; but it is generally of so fixed a nature as to do no harm, since it is not volatilized so as to be inhaled with the ether.

I have named all the usual impurities found in commercial ether; all that will be likely to be met with. Under the head Chloroform, I shall describe other tests, which will be applicable in the detection of mixtures of that agent with ether.

At the present time pharmaceutists are prepared to furnish good and trustworthy ether for anæsthetic uses. It is made in Philadelphia, Brooklyn, N. Y., and in Boston, and the samples I have tested were generally sufficiently pure for our purposes; at least, I have rarely found any matters present that would act injuriously, with the exception of alcohol, which is now and then left in the ether. This is very common in ordinary commercial ether, which is utterly unfit for use as an anæsthetic agent.

CHAPTER IV.

CHLOROFORM.

When the anæsthetic effects of ether became known in Europe, Prof. J. Y. Simpson, of Edinburgh, was one of its most active promulgators, and continued for about a year to make use of that agent. In 1847 he says, "I was seeking for a substitute for ether, when Mr. Waldie (the chemist) suggested the employment of chloroform," which he procured and tried with success. It appears, however, that M. Flourens had anticipated Dr. Simpson, by having made successful experiments on animals with chloroform some months before Dr. Simpson's experiment.

This substitute for a while seemed to eclipse ether, the anæsthetic agent first employed; but at length we began to hear of sudden deaths resulting from the action of this too powerful substitute for ether, and a just alarm has caused the medical world to employ it with more caution than heretofore.

It is necessary for me to give a short history of the discovery of chloroform, its mode of preparation in its present state, and the methods of testing it, to determine its purity.

Chloroform was discovered by Soubeiran, in 1831. In 1832 Liebig and Dumas made more extended researches concerning it, and submitted it to chemical analysis, showing thereby that it is a ter-chloride of formyl, having the formula C^2 H Cl^3. M. Dumas by analysis obtained the following results:

			PER CENT.	
			Theory.	Analysis.
2 equivalents of	Carbon,	12·0	= 10·04	= 10·24
1 "	Hydrogen,	1·0	0·84	0·83
3 "	Chlorine,	106·5	89·12	88·93
= 1 equiv'nt of chloroform		= 119·5	100·00	100·00

while Formic acid consists of C^2 H O^3. Therefore in chloroform three atoms of chlorine replaces three atoms of oxygen of formic acid. The importance of these considerations will be apparent, when I come to speak of the toxical effects of chloroform. Dr. Simpson gives as the receipt, by which the chloroform he employed was made, the following proportions of ingredients:

"Bleaching powder, - - lbs. iv.
Water, - - - - - - lbs. xii.
Alcohol, - - - - - oz. xii.

Mix in a capacious retort or still, and distil so long as a dense liquid comes over and sinks in the water which distils over with it."

This chloroform, being drawn off beneath the water, is washed and agitated with concentrated sulphuric acid, which it floats upon. The acid is then drawn off from below, and the chloroform is again washed and re-distilled, a little lime being added to take up acid.

It should have a density of from 1·49 to 1·496 at fifty deg. Fahr. It is transparent and colorless, is very volatile, has a heavy but somnolent aromatic odor, and should evaporate from a sheet of filtering paper, leaving no smell on it. It should not turn brown, when agitated with concentrated oil of vitriol; for if it does, fusel oil is present, and the chloroform is not suitable for inhalation. Of this I shall treat more fully presently.

Muspratt gives the following directions for the manufac-

ture of chloroform, in a large way: One hundred and thirty pounds of oxychloride of calcium (bleaching powder), and seven pounds of lime, with sufficient water to make them into a paste, are introduced into a capacious alembic of common earthen ware. When well stirred together more water is added, with twenty-five pounds of rectified spirit of wine. Care must be taken that the still is not more than half full. The head of the still is then well fitted on, and a gentle heat is applied to the still by means of steam. The chloroform, which distils over, is washed with water. The washings and supernatant fluid, with half the above quantity of bleaching powder, lime and spirit, are introduced into the still, and the several processes are repeated.

The whole product, thus obtained, is poured into an ordinary still, with four or five times its weight of water, and a small quantity of lime, and distilled. The distillate is then separated and washed as usual, and agitated with a little very dry carbonate of potash, to remove any water that may adhere to it, and then it is rectified. This process is nearly the same as that given by Berzelius, which I have employed. Simpson's formula also gives good results, in a small way. Muspratt gives the following proportions for operations on a limited scale:

Bleaching powder, - -	1 lb.
Water, - - - - - -	3 lbs.
Pure alcohol, - - - -	3 lbs.

This distilled gives about three ounces of chloroform, and is to be purified as above directed. According to my experience there is too large a proportion of alcohol in this mixture to give profitable results; for so much undecomposed alcohol will come over, as to prevent the chloroform from separating thoroughly, by the action of water, it being soluble to a considerable extent in weak spirits. It is

a good formula for the preparation of the alcoholic solution of chloroform, improperly called chloric ether. This mixture of chloroform and alcohol may be burned in a lamp with a wick, and forms by combustion chlorhydric acid and a little free chlorine, besides carbonic acid and water. The chlorhydric acid and chlorine, so formed, act as deodorizers, and the lamp has been used for the purposes of disinfection. Pure chloroform will not burn by itself, and its vapor is not explosive.

Chloroform dissolves in water in small proportions, but is more readily dissolved by a mixture of alcohol and water, and is soluble in all proportions in alcohol. Three parts of alcohol and one part of chloroform, mixed, produces an excellent remedy for toothache. This preparation I introduced into public use in 1834 for that purpose.

When a strong alcoholic solution of chloroform is poured into water, the chloroform is separated, the alcohol combining with the water and the chloroform being set free. By this method we readily estimate the chloroform in an alcoholic solution of it. If, however, the proportion of chloroform is small in relation to that of the alcohol, the former is not separated, but it at first becomes milky, and then the chloroform is taken up again. Nitrate of silver solution dropped into pure chloroform gives no precipitate, nor is chloride of gold decomposed, even if boiled with it.

TESTS FOR CHLOROFORM.

The following are the approved tests for chloroform:

1st, For *Alchohol.* Take its specific gravity at 60 deg. Fahr.; if it is lower than 1·496, alcohol or ether may be present. To test for alcohol, take a graduated glass test tube, put in a given measure of the chloroform, and add water; then shake up quickly. Stop the tube, and set it in a cold place, until the chloroform has entirely subsided;

observe how many divisions the chloroform has contracted to, and thus measure the proportion of alcohol that has been dissolved by the water.

2d. For *Aldehyde*. Hydrated oxide of silver is reduced by it to the metallic state, without heating. A solution of caustic potash turns the aldehyde in chloroform brown.

3d. *Formic Acid* reduces nitrate of silver to the metallic state, when chloroform containing it is mingled with a solution of the nitrate of silver, and is heated.

4th. *Chlorhydric or Muriatic Acid* is detected, first, by the acrid and pungent fumes of the gas; secondly, by the formation of a dense white cloud when a feather, dipped in aqua ammonia, is brought over the impure chloroform; thirdly, by the formation of a white precipitate of chloride of silver, when nitrate of silver solution is added. Litmus paper, wet with pure water, is reddened, when held over the mouth of a bottle containing chloroform, giving out chlorhydric acid gas.

5th. *Hypochlorous Acid* may be detected by its odor, and by its first reddening litmus paper and then partially bleaching it.

6th. No ready and satisfactory tests for the presence of *Methyle* are yet known, but its effects on inhalation are known to be a peculiar throbbing headache, and rapid prostration of the vital powers. Dr. Letheby states that these effects may be observed on merely smelling of chloroform containing these compounds, the headache coming on in a short time.

7th. *Sulphurous Acid* may be detected by its odor, it being the same as that of a burning sulphur match, and by its bleaching litmus paper.

8th. *Hydrochloric Ether* may be washed out from chloroform by water, and be obtained by distillation of the aqueous mixture.

Dr. Letheby states that chloroform should be perfectly colorless and free from opacity. That its specific gravity should be near 1·496. It should neither redden nor bleach litmus paper. It should not become opaque when dropped into water. It should not become cloudy and white when nitrate of silver solution is added to it. It should not coagulate white of egg; and, we may add, it should not turn brown when concentrated sulphuric acid is mingled with it, nor should it be made brown by the action of a strong solution of hydrate of potassa. It should leave no odor in a sheet of blotting paper from which it is evaporated.

By these tests the physician or surgeon, who employs chloroform as an anæsthetic may know whether he has a pure or an impure article to operate with.

OTHER ANÆSTHETIC AGENTS.

It may be proper for me to give a list of the other agents which have been proposed as substitutes for ether, since some persons may wish to make experiments on animals with them, though few will be willing to test the efficacy of some of those I shall mark as dangerous, upon any human individual.

M. Bouisson, in his work on the use of anæsthetic agents gives the following list of substitutes for ether, which have been tested.

1st, Hydrochloric ether (first employed mixed with sulphuric ether by M. Flourens, of Paris, in 1847).

2d, Acetic ether (M. Figuier). See *Compte Rendu* of the French Academy of Sciences, 1848, and M. Bouisson's *Traité*, 1850, Paris.

3d, Nitrous ether (M. Flourens).

4th, Nitric ether (Dr. Simpson, exp. on animals).

5th, Aldehyde (M. Poggiale).

6th, Chloride of hydrocarbon (Dr. Nunnelly).

7th, Formomethyle (M. Bouisson).

8th, Benzine (Drs. Simpson and Snow).

9th, Bi-sulphide of carbon. (Name of experimenter not known). Norway Morganblad, 1848.

10th, Amelyne (Dr. Snow, of London).

11th, Oil of Turpentine has been employed by an English naval surgeon.

12th, Kerosolene has been tried by me, and by Dr. H. J. Bigelow with partial success, but it is not of uniform composition and cannot be depended upon.

I have tried Nos. 1, 5, 6, 9 and 12, upon my own person, and No. 9 I have administered to one of my pupils with rather alarming results. I have also tried it on myself several times. It is too powerful and dangerous, producing well-marked asphyxia.

I have tried the chloride of methyl, and found it to act like chloroform; but it produces severe headache afterwards.

I have tried formic ether and œnanthic ether, with very unpleasant effects, and without the production of the anæsthetic state. Severe headache followed the experiments.

Benzole, also, proved quite unsatisfactory, and it irritated the fauces and larynx. I do not regard these agents as susceptible of being substituted for pure sulphuric ether.

I will give here the results stated by M. Bouisson in his admirable treatise (*Méthode Anesthésique*, Paris, 1850), respecting those agents, that have not been tried by me, remarking that M. Bouisson himself is decidedly in favor of adhering to the use of ether vapor as originally proposed and employed by me. My remarks of course accompany his statements.

Chloride of ethyle, or hydrochloric ether, is made by saturating alcohol with chlorhydric acid gas, and by dis-

tilling the liquid in a water bath, and condensing the ether in a flask of water, surrounded by ice and salt.

Hydrochloric ether boils at eleven deg. Centigrade or forty-two deg. Fahr. M. Flourens first employed this ether in the place of sulphuric ether (oxide of ethyle), and for comparison with it, and found that it produced the same effects. It is so volatile that it is difficult to keep and can be preserved only in cold weather; hence it is not employed to any extent, in actual practice, for it would be necessary to keep it constantly surrounded by ice, to prevent its escape by evaporation.

Acetate of the oxide of ethyle, or acetic ether, is a colorless liquid, having an aromatic odor, somewhat between ether and acetic acid. Its density is 0·86, and boiling point seventy-four deg. Cent., or ninety-five deg. Fahr. This ether, being less volatile than oxide of ethyle, is not so readily administered in vapor, by inhalation; but according to M. Figuier, it produces effects analogous to those of sulphuric ether. Tried on a puppy of two and a half months, by M. Figuier, it produced insensibility in five minutes, so that no pain was occasioned by amputation and cauterization of his tail; but it took ten minutes to render an adult dog insensible to pain. M. Bouisson has tried acetic ether, in surgical operations on man; but did not obtain such prompt results, as with sulphuric ether. It required twenty minutes to produce insensibility in a patient, from whose cheek a small cancerous tumor was excised by that surgeon. He thinks this ether is suitable for persons who are easily affected by anæsthetic agents, and that it produces less coughing than sulphuric ether. M. Chambert agrees with M. Bouisson in this opinion.

Nitrous ether (nitrite of oxide of ethyle) has a density of 0·95 and boils at sixteen deg. Centigrade or fifty-one deg. Fahr. This ether is a *deadly poison* when inhaled,

and its use should be avoided. M. Flourens has verified its poisonous properties by experiments on animals, and a servant maid of a druggist was killed by sleeping in a room where a carboy of it was broken under her bed (Ed. *Med. & Surg. Journal*, vol. xxxv. p. 452). This etherial fluid, of course, is to be thrown out of the list of anæsthetic agents.

Nitric ether (nitrate of ethyle) has been used in experiments on man and animals by Dr. Simpson, who declares that it produces anæsthetic effects on man, when fifty or sixty drops of it are inhaled from a handkerchief. He regards it as free from danger. But this is not a correct opinion ; for severe headache and vertigo follows its inhalation, as I know from my personal experience, and I would not recommend its trial. In case it is breathed freely, I have no doubt it would produce fatal results. I therefore reject it.

Aldehyde (hydrate of the oxide of ethyle) was proposed by M. Poggiale, professor of chemistry in the Val-de-Grace in 1848, as a substitute for ether and chloroform. He had tested it on animals, with what he regarded as successful results ; but experiments made by others, on men, proved that it was a very disagreeable, if not dangerous, substance. Dr. Simpson proved that it produced severe cough, great dyspnæa, and headache. The same results were obtained by me in experiments on my own person in 1848, and I at once denounced aldehyde as not being a safe and proper anæsthetic agent.

Chloride of hydrocarbon (or the Dutch oil) was proposed by Dr. Nunnelly, of Leeds, as an anæsthetic agent; but experience has proved that it produces severe irritation of the throat, and that it is not so good an anæsthetic as chloroform ; furthermore it is a rare and costly article not known in commerce.

Formomethyle is mentioned by M. Bouisson as an anæs-

thetic, somewhat between ether and chloroform. It is obtained by distilling wood naptha (esprit de bois) with a mixture of diluted sulphurous acid and per oxide of manganese. It is an agreeable aromatic liquid. It boils at forty-two deg. Cent., or 107 deg. Fahr. It has been tried on dogs with success, but never upon man. Its value cannot be superior to that of sulphuric ether, though regarded by M. Bouisson as between ether and chloroform; furthermore, it is a rare and costly substance.

Benzine, produced by the distillation of benzoic acid with lime, has been proposed as a substitute for ether and chloroform; but it has proved unsuccessful in the hands of Drs. Simpson and Snow, who first employed it, and it should not be used in operations on man.

Bi-sulphide of carbon is obtained by passing the vapor of sulphur over hot charcoal, and collecting the volatile product in pounded ice, and then re-distilling it and condensing it again in ice and water. This very disagreeable smelling liquid was proposed by some one in Christiana, Norway, as a substitute for ether. I do not know the name of the writer, but the article was published in a Norwegian newspaper called the Morgenblad, in 1848. On reading it, I immediately undertook a series of experiments with this volatile liquid, and found that it did possess anæsthetic properties, but that its use was not only very disagreeable, but also highly dangerous, owing to the remarkable effects of the bi-sulphide of carbon vapor on the circulation, and on the respiratory organs. Its effect is very sudden, and a person under its influence becomes deadly pale, with livid lips, indicating partial asphyxia. After trying it on my own person, and having been rendered so suddenly unconscious that I was unable to note any of the phenomena, I obtained the consent of Mr. Dickinson, one of my pupils, that I should administer it to him. Though the experiment was performed

with the utmost care, the effects upon him were such as greatly to alarm me, and I hastened to resuscitate him. I became convinced that this agent was wholly unfit to be inhaled as an anæsthetic; and I believe none who have since tried it would be willing to sanction its introduction into practical surgery.

A NEW ANÆSTHETIC.

One of the volatile products obtained in the preparation of kerosene or coal oil, has been long in the market. It is sold under the name of kerosolene, and is used as a solvent of greasy matters.

In 1859 I obtained some of this volatile oil, for the purpose of testing its value as an anæsthetic agent. My experiments were unsatisfactory, the kerosolene irritating the fauces and larynx.

Recently, by improved processes, Mr. Merrill, of Downer's oil works, has succeeded in preparing a more volatile and less irritating oil, which he brought to the Boston Society for Medical Improvement, to have tried in the place of ether as an anæsthetic. The experimental trial of its powers, made under the auspices of the Society, by Dr. H. J. Bigelow, proved that it possessed anæsthetic properties, but that there was a tendency to asphyxia from its action on the blood. At the Hospital it produced convulsive spasms, due to this state of the blood. This we should have been inclined to believe, considering that it is a mixture of highly carbonated oils, without any oxygen in their composition; and also because it is more volatile than ether, and therefore forms a larger proportion with the inhaled air, its tension being such that the lighter portions of it boil at seventy or seventy-five deg. Fahr. A sample furnished me by Mr. Atwood, has the specific gravity of 0·634 at sixty-six deg. Fahr., its density being much less than that of pure ether.

The continued improvements in the separation of these volatile oils will, I doubt not, ultimately bring forth a product which may be safely employed for inhalation; but the kerosolene, as now made, is too variable a mixture to be safely employed for this purpose. It is liable to contain matters that act injuriously; for instance, such as the bisulphide of carbon.

"*Amyline.* "This new anæsthetic agent, discovered by Dr. Snow, of London, was lately the subject of discussion before the Imperial Academy of Medecine, of Paris. Velpeau, Malgaigne and other distinguished surgeons, who had given the new agent a careful experimentation in their hospital practice, pronounced it inferior to chloroform, and the Academy voted its condemnation. Unfortunately for the amyline, a case of death had just occurred from its use in the hands of the inventor, Dr. Snow, and this circumstance, it may be imagined, did not contribute to its reputation as a practical agent."—*Boston Traveller*, June 29th, 1857.

Oil of Turpentine. John Wilmshurst, surgeon of emigrant ship Indiana, has made use of oil of turpentine as a substitute for chloroform. Applied in the same way in which chloroform is commonly administered, by means of a handkerchief sprinkled with it, it produced similar effects, "a gentle sleep and state of anæsthesia." No headache, or other unpleasant symptoms, followed. He made use of this anæsthetic in several cases. One was a case of supra-orbital neuralgia; another in an operation of petty surgery, the extraction of a needle from sensitive parts; and he also administered it in some cases of cramps and convulsions. He desires that surgeons should test this agent in other cases. I should, from the known effects of oil of turpentine, fear that it would irritate the kidneys and bladder.

CHAPTER V.

INTRODUCTION OF ETHERIZATION INTO SURGICAL PRACTICE.

Éviter la douleur dans les opérations, est une chimère qu'il n'est pas permis de poursuivre aujourd'hui. Instrument tranchant et douleur, en médecine opératoire, sont deux mots qui ne se présentent point l'un sans l'autre à l'esprit des malades, et dont il faut nécessairement admettre l'association.—*Médecine Opératoire,* par M. Velpeau; Paris, 1839, t. 1, p. 32.

TRANSLATION.

"To avoid pain, in surgical operations, is a chimera, which it is not permitted to follow at this day. Cutting instrument and pain, in operative surgery, are two words, which never present themselves the one without the other to the mind of the patient, and it is necessary to admit the connection."

This was the opinion, entertained by one of the most skilful surgeons of the age, at the time when he published his celebrated work on Operative Surgery.

It is proper for me to state, at once, that he was also one of the very first to adopt and to defend my discovery of etherization, which he and the celebrated surgeon of the Hotel Dieu, Baron Roux, more fully illustrated and confirmed, one week after my letters had been read in the Academy of Sciences, than any other surgeons in the world. These great and magnanimous men were not afraid of being charged with inconsistency, because they departed from opinions once expressed. They were open

to the light of new experience, and deserve the hearty thanks of all lovers of truth and humanity. I give M. Velpeau's statement, to show the state of knowledge on the subject in Europe in 1839; and I presume no one will doubt that M. Velpeau was fully informed in the history of his art.

Having confided my discovery to twelve of my friends, most of whom are gentlemen devoted to science, and some of them physicians and dentists, I considered it safe, so far as priority of discovery was concerned. It was my intention to revisit Europe, and to bring out this discovery in the great hospitals of Paris, where I felt confident I should be treated with courtesy and fairness; but I was at the time actively engaged in the Geological Survey of the State of New Hampshire; and while my Report was in press, was called upon to explore the wilderness of Lake Superior land district, for copper mines, so that I had not a month that could be spared for a voyage to Europe. Hence my procrastination. Under these circumstances, I employed a dentist, a nominal medical pupil of mine, Mr. W. T. G. Morton, to make trial of my discovery, in dental surgery, which he consented to do, if I would take the entire responsibility. This I did at once before two witnesses, George O. Barnes and James McIntire, two of my chemical pupils, as will be seen is proved by their sworn depositions.

The first case in which the ether was tried, in preventing the pain arising from extraction of teeth, was that of Eben H. Frost, a wood sawyer, of Boston, the tooth having been extracted by the dentist above named, who operated as directed by me. It proved successful, the patient alleging that he felt no pain. This operation took place on the 30th of September, 1846. The case was promptly reported to me the next morning. I then engaged this dentist to go to Dr. John C. Warren, and to ask him to

test the ether in a more severe operation, at the Hospital.* The reason why I did not go in person, was that I was at that time engaged in chemical work for others, which could not be left. I proposed to see Dr. Warren a few days afterwards, as I did. Mr. Morton did as directed, and came at once and reported to me that "Dr. Warren had consented to try the experiment." (See statement of the claims of Charles T. Jackson, M. D., to the discovery of the application of sulphuric ether to the prevention of pain, by Martin Gay, M. D., 1847; Defence of Dr. Charles T. Jackson's claims to the Discovery of Etherization, by J. L. & H. Lord, attorneys, in *Littell's Living Age*, 1848; Principles recognized by Scientific men, applied to the Ether controversy, by J. H. Abbot, Esq., *Littell's Living Age*, No. 214, 1848, also same work, No. 272, p. 234, 1849; Reports of Hon. Drs. F. W. Lord and John Jones, of Congressional Committee, 30th Congress, second Session, 1849; also, Vindication of the Claims of Dr. C. T. Jackson to the Discovery of Etherization, Cong. Report by Hon. Edward Stanley and Alexander Evans, Cong. Committee, 1852.)

I was not informed when the trial of the ether was to be made at the Hospital, and it was done the next day, without notifying me that I might attend and witness the effects. The operation was one of minor surgery, the removal of a small tumor from the cheek, near the angle of the jaw. It was partially successful, the patient feel-

* There is evidence that Dr. C. W. Long, of Athens, Ga., performed surgical operations on persons in an etherized state, on March 30th and July 3d, 1842, but a few months after I made the discovery of anæsthesia. He also operated with ether Sept. 9th, 1843, and Jan. 8th, 1845, as appears by his records and evidence. (See my article in Boston Med. & Surg. Journal, April 11th, 1861.) In 1844, Dr. Smiley amputated an arm of a person who had inhaled ether, from an ethereal solution of opium. It is true, however, that Dr Smiley did not then know that the ether produced the insensible state, and thought the effect was due to the opium. (See Dr. Smiley's published Lecture.) These facts came to my knowledge but a few years ago, and long after the publication of my discovery.

ing the operation, but suffering no pain from it. I then saw Dr. Warren myself, and found that he had not been informed what the anæsthetic agent was, that had been employed in this case, nor even that Mr. Morton came to him as my messenger. He said that Mr. Morton told him he "*had got hold of a method* of preventing pain in surgical operations*, and wished him to try it." I then stated to Dr. Warren, that the supposed "compound" was nothing but pure washed sulphuric ether, and that I had sent my messenger to him to request him to test it in a severe surgical operation. I asked him to give it a trial in a capital operation, an amputation of a large limb, if possible. He said that there would be an amputation to be done at the end of the week, on Saturday, and requested me to come to the Hospital and administer the ether myself, as he did "not like to have such a quackish fellow as Morton about the Hospital." I replied that I was under obligations to be at Liberty, in Maryland, on Monday, and so could not go to the Hospital myself, as I should leave for New York on Friday, but would fully instruct Morton and send him to administer the ether. The next morning (Friday) I received a note from Dr. Warren, asking me to communicate, in writing, the nature of the agent employed for the prevention of pain, and again inviting me to administer it myself, and to procure the apparatus for the use of the Hospital. I wrote in reply, stating that the article was pure ether, but said that I should leave that evening for Maryland, and would send my pupil to administer the ether, in the case we had arranged. The valved inhaler, as modified by Dr. Gould, I stated, was not mine. I then went to Baltimore, in company with Mr. J. Peabody, and was absent at the time of the operation. On my way back from Maryland, Mr. Pea-

* In Dr. Warren's book on Etherization, p. 4, he makes use of the words, "he had possession of a means," &c.

body and myself eagerly searched the Boston newspapers, expecting to see an account of this operation, and we were much disappointed at not finding any mention of it. On arrival in Boston, I found that the operation had been postponed a week, and that Dr. Hayward had just returned from Europe, and taken charge of the case and had performed the amputation a few days before my return. I then, by invitation of Dr. Warren, went with him to see an operation on a private patient at the Bromfield House, where a small tumor was removed from the thigh of a man, the Hospital house surgeon administering the ether. This patient, a stout man, was etherized in a few minutes, and the operation was performed without his suffering any sensation of pain, though he turned away from the knife as though there was an organic or automatic revulsion from the surgical instrument; but on his recovery from the effects of the ether, he said he had felt nothing, and had had pleasant dreams.

During the winter of 1846, and until I was called to my Geological Survey on Lake Superior, by a commission from the United States government, in the spring of 1847, I continued to attend the most important surgical operations at the Massachusetts General Hospital, by invitation of Dr. John C. Warren, the chief surgeon, and at his request frequently gave advice and directions, so as to avoid accidents in etherizing patients. I have also frequently assisted my surgical friends in their operations, by administering ether and chloroform, either separately or mixed in the proportions I have recommended for army use.

At this time a patent, against which I had most earnestly protested, was in negotiation, and my name was most reluctantly, on my part, allowed to go into the petition, and only for the sake of securing my scientific rights, as the discoverer, Mr. Morton's name having been against my protest introduced as a joint inventor, which, I was

informed by the solicitor was in accordance with patent law (but which I learned afterwards was an erroneous opinion, and that what Morton did was not sufficient ground for him to claim that distinction). I determined to have this question of discovery settled, and also to ask the highest scientific tribunal in the world to investigate the evidence of all persons who might lay claim to it; for I had learned that there were numerous other claimants, both in this country and in Europe,—sixteen claimants in all. On the 13th of November, 1846, I wrote to the Academy of Sciences of France, sealed the letter and showed it to Mr. Morton's agent, informing him of its contents. By his earnest solicitation, and his promise that "all should be set right," if I would wait, I agreed not to send my letter in the steamer of that month, and waited till the first day of December. Then I called on that agent again, and told him I should send my letter, when he said, "We sent and secured a patent in France by the last steamer, and it is all safe now"! I said, "We will see;" and having written another letter, stating this new matter, and asking the Academy to protect my scientific rights, as the discoverer, I inclosed the first in it, and sent the double letter to France by the first steamer in December. When it reached its destination, December 28th, 1846, on account of the information contained in the outside letter, and under the erroneous belief that I wished to take out letters patent in France, the letters were sealed by the Academy, in order to secure my legal rights in the case, and the papers were placed on file "*en paquet cacheté*," and a letter from M. De Beaumont informed me of this delay. I wrote immediately, "Open the letter at once; I do not wish for any patent, but only a commission of the Academy to examine into the discovery." My letter was read before the Academy on the 18th of January, 1847, as will be seen by *Compte Rendu* for that month (page 74). Since I kept no

copies, I am obliged to translate my letters from the French rendering of them, as given in the *Compte Rendu* for 1847. The portions omitted, in the work in question, relate only to the attempts of Mr. Morton's agent to forestall me in France, by application to the patent office. This proved in the end of no consequence, since patents are not given in France to enable any one to monopolize the use of any remedial agent.

Extract from a letter, which I addressed to M. L. Élie De Beaumont, dated Boston, Feb. 28th, 1847.

"In relation to taking out a patent (in the United States), I had no other idea than to prevent those, who have no right to speculate in my discovery. . . . .

"Numerous competitors claim this discovery, both in this country and in Europe, and we have no other means here of establishing priority of discovery, by law, but to make use of the laws of the United States with respect to patents. I have therefore taken out a patent in this country to secure my rights; and to have my motives understood, I declared in the letters, in which this patent was solicited, *that I was strongly opposed to the idea of taking out a patent for any means for the prevention of human suffering; but that I decided to do so in order to establish legally my rights as the author of the discovery, and to enable me to give my rights to others, that they might make use of my method.*

"The patent in the United States bears the names of Jackson and Morton, because it was represented to me, by the solicitor of the patent, that Mr. Morton, having made experiments under my directions, ought necessarily to figure in it. This, I learned since, was not correct. He is proprietor of the patent for the United States by my assignment, but he has no rights to it out of this country."

I would add here, that he never paid me a cent for said assignment, and that now the patent is vacated by law, on my protest against its extension.

No application was made by me for any patent in Europe, and I only desired the Academy to investigate the matter, and to verify the statements made by me.

The discussion which followed is very interesting, as showing the state of knowledge on this subject at the time. It is sufficient here to say, that the Academy did appoint a most able commission, and that everything I had written was fully proved by them, and duly reported. Whatever errors I may have committed here, it cannot be doubted that I took the right course in Europe; and it is certain that no person had operated successfully with this agent in France before the arrival of my letter, giving the proper instructions as to its use in surgery.*

Translation of Extracts from my letters to M. De Beaumont.

"On the 18th of January, 1847, M. Élie DeBeaumont asks for the opening of a sealed paquet (paquet cacheté), which he had deposited in the session of 28th December, 1846. It contained two letters of M. Jackson, of which these are the extracts:

FIRST LETTER.

"Boston, 13th November, 1846.

"I ask permission to communicate, through you, to the Academy of Sciences, a discovery which I have made, and which I believe to be important for the relief of suffering humanity, and of great value in surgical art. It is five or six years since I recognized the peculiar state of insensibility

* Without any desire to diminish the credit due to any person, who aided in verifying my discovery, or in extending a knowledge of it, I distinctly affirm that its free use, in the Massachusetts General Hospital, was effected by me; and that the breaking up of an odious patent, and making etherization free to all mankind, was wholly my act. This the evidence and Records of the Patent Office will fully prove.

into which the nervous system is plunged by the inhalation of the vapor of pure sulphuric ether, which I inhaled in large quantities, first for experiment, and afterwards when suffering from a severe inflammation, caused by the inhalation of chlorine. I have recently made use of this fact, by inducing a dentist of this city to administer the vapor of ether to persons whose teeth he was about to extract. It was observed that these persons did not suffer any pain during the operations, and that no inconvenience resulted from the administration of ether.

"I next urged this dentist to go to the Massachusetts General Hospital, and administer the ether vapor to a patient who was to undergo a painful surgical operation. The result was, that the patient did not feel the least pain, and did well afterwards. An operation near the jaw, the amputation of a limb, and the excision of a tumor were the subjects of the first surgical experiments.

"Since then numerous surgical operations have been performed, on different patients, with like success, and always without pain. The patients have convalesced well, not having suffered any nervous shock.

"I desire that the Academy of Sciences will have the goodness to appoint a commission to make the necessary experiments, in order to prove the exactitude of the assertions which I address you, concerning the remarkable effects produced by the inhalation of ether vapor.

"One may very conveniently breathe this vapor, by dipping a large sponge in ether, placing it in a short conical tube, or in a funnel, and drawing the atmospheric air into the lungs, through the sponge thus saturated with ether. The air may be ejected by the nose, or valves may be placed on the tube or funnel, so that the breath may not traverse the sponge and weaken the ether by aqueous vapor.

"At the end of a few minutes the patient falls into a

very peculiar state of sleep and may be submitted to any surgical operation without his feeling the least pain; his pulse becomes generally a little more rapid, and his eyes shine, as from the effect of a peculiar excitement. When he recovers from this state, in a few minutes, he will say to you that he has been asleep and has dreamed.

"Ordinary weak (alcoholic) ether will not produce the proper effect. The patient will only be made drunk by it, and will suffer headache afterwards. We should use, therefore, only the most highly rectified ether.

"If a dentist extracts teeth in the evening, he should employ a Davy safety lamp, for a naked flame might cause an explosion if brought near the mouth.

"In the administration of ether vapor it is important to have it in large volume, so that it may be inhaled freely and produce its effects promptly, because we thus avoid all disagreeable sensations; but there is no danger to be feared from prolonged inhalation of ether vapor, provided that atmospheric air also is properly admitted. In prolonged operations we apply the ether vapor several times, at proper intervals, so as to keep the patient in this (ethereal) sleep. CHARLES T. JACKSON."

EXTRACT FROM SECOND LETTER.

"BOSTON, December 1st, 1846.

"The application of ether vapor has been fully tried in this country, and is in full and successful use in the Massachusetts General Hospital."

M. Velpeau having made some critical remarks, and expressed doubts of the efficacy and safety of etherization, M. Roux said:

"We find, without doubt, in the communications of M. Jackson the most secure methods, and the most appropriate apparatus for submitting patients to the inhalations

named. It is one of the chief things to be desired concerning experiments, begun in America, and which are to be continued with us, *I take part in it from this moment.*"

While my letters were under the seals of the Academy, Dr. Warren wrote to M. Velpeau, announcing his success in the use of ether, and my friend Dr. J. D. Fisher had written to his nephew, Dr. F. Willis Fisher, then in Paris, announcing the same facts, and sending him an inhaler such as was used at the Mass. General Hospital. Dr. Fisher called on M. Velpeau and requested him to make a trial of ether in la Charité Hospital, with this apparatus; but it appears from the communication made by that *savant*, that he met with no success. (See *Compte Rendu*, page 77, session of 18th January, 1847.)

It appears, also, that letters had been written by some of our hospital surgeons to London, and that the trials of ether there had met with somewhat better success, with, however, many failures. The difficulties arose from imperfect instructions in the use of this agent, no directions as to the purity of the ether required, nor the proper mode of administering its vapor, having been communicated, and the essential requisite, a free commingling of atmospheric air with the ether vapor, having been omitted. Hence, especially in the first trials of ether in France, the vapor given from a bladder in hot water, and without admixture of air, suffocated their patients, or produced partial asphyxia. This was the precise method employed by two boys in Philadelphia many years ago, by which experiment one of them lost his life by asphyxia.

It was not until my letters were read, that any proper directions were received in Europe, and then all the experiments proved successful. Then it was that M. Roux uttered his exclamation: "J'y prends part en ce moment, mais je n'ai pas été satisfait de la manière dont fonctionnent les appareils que j'ai pu employer. C'est peut-être

à cause de cela que je ne suis point encore parvenu à produire des effets sensibles sur les malades qui se sont prêtés à mes expériences."

Referring to the newspaper notices of experiments made in Boston and in England, Velpeau said:

"Maintenant, faut-il prendre à la lettre toutes les merveilles qui se débitent à ce sujet dans les journaux politiques? Non, sans doute. Voici les résultats de l'expérience jusqu'à présent. Un de mes malades, homme fort et robuste, qui devait subir l'amputation d'un doigt, n'a point perdu la sensibilité, est resté complétement réfractaire à l'action de la vapeur éthérée. Un autre a été pris, au bout de dix minutes, d'une sorte d'ivresse, avec loquacité, avec un air fanfaron tout particulier, qui ne l'ont point empêché de sentir vivement la petite opération que je lui ai pratiquée. Un jeune Américain est tombé immobile au bout de trois minutes, et s'est laissé extraire une dent sans manifester de douleur. Revenu à lui, il a soutenu avoir souffert beaucoup, mais que l'état d'extase où il était lui avait ôté la peur et tout possibilité de se remuer. Trois autres personnes ont inspiré la vapeur d'éther pendant cinq, huit, dix minutes sans résultats. Un jeune médecin et un élève qui suivent l'hôpital ont, au contraire, été promptement en état d'insensibilité complète, de manière à rester parfaitement indifférents aux piqûres d'épingles, de lancettes, etc., aux pincements qui ont été exercés sur eux."—*Compte Rendu*, 18 Jan., 1847, p. 77.

TRANSLATION.

"Now are we to accept literally all these marvels, in relation to the matter, which are retailed in the newspapers? No! without doubt. Here are the results of experience up to the present time:

"One of my patients, a strong and robust man, whose finger had to be amputated, did not lose sensibility, and remained completely refractory to the ether vapor. Another in about ten minutes was rendered drunk, and was loquacious with a blustering manner (avec un air fanfaron)

quite peculiar, which, however, did not prevent his feeling most sharply the small operation which I performed upon him.

"A young American [Dr. Francis W. Fisher,] after three minutes fell down immovable and a tooth was extracted from him, without his manifesting pain. When he recovered, he maintained that he had suffered much pain, but the state of extasy he was in prevented fear and all possibility of his moving. [This was a state of partial asphyxia, such as frequently happened in a dentist's office in this city, where proper precautions were not taken for the admission of atmospheric air with the ether vapor.]

"Three other persons inhaled the ether for five, eight, and ten minutes, without effect. One young physician and a student in the hospital have, on the other hand, been promptly rendered insensible, so as to remain indifferent to the pricks of pins, lancets, and the pinching which were tried upon them."

The reader will please to observe that we have here the results of experiments made during the month that my letters were under seal in the Academy, and all the information the French surgeons had, was gathered from American and English newspapers, and from letters addressed to them by the surgeons and some of the physicians of the Massachusetts General Hospital. Please observe how the scene changed at the next session, on the 1st Feb., 1847.

Only one week had passed after the reading of my communications, when Messrs. Velpeau and Roux, who had been diligently engaged in experiments, made additional communications to the Academy, fully sustaining the value of etherization. I will here give a condensed statement of their results, requesting those who wish to read all the minor details, to refer to the original papers in the *Compte Rendu*, of the session for Feb. 1st, 1847. The following are the cases reported:

1st. Case of a young man with fracture of the thigh-bone, difficult to reduce on account of violent muscular contractions. This patient was robust, vigorous, and extremely irritable. His muscles in spite of him forcibly contracted almost convulsively the moment any attempt was made to reduce the fracture. Submitted to ethereal inhalation, he was soon under its influence, about five minutes sufficing to produce relaxation of the muscles, when the fractured bone was reduced and the thigh elongated without his perceiving what was done, or suffering any pain.

2d. The next case is more interesting, as it concerns a surgical operation on a most sensitive portion of the body. Velpeau states that the next day after the above-named operation, he had to operate on a vigorous young man and remove a tumor from the parotidean fossa under the left ear. This region, filled with nerves, vessels, fibrous membranes, and glands, closely packed, is one of those as every surgeon knows, where operations create the most severe pain. Submitted to etherization; at the end of three minutes the patient became insensible; the operation was half done without his having moved, or uttered the least cry. Afterwards he began to talk, wished to move, and begged us to remove our "camphor, which annoyed him," but without having the air of knowing what was doing to him. When the operation was completed, little by little, he returned to his consciousness and senses, and explained that he had been dreaming, and believed himself playing at billiards. The action and the words he had spoken he said concerned his play; and he also dreamed that some one was taking away his horse, which he had left at the door of the billiard rooms. As to the operation, he had not felt it at all, but remembered that he had heard the strokes of the knife "*le cric-crac*," but that he did not feel anything, and had not suffered the least pain.

3. The third case was the opening of a large abscess in

the breast of a young woman. M. Velpeau proposed that she should inhale the ether, and she began to do so as if to try it, without any idea of going on with it to the end. Four or five inspirations, in less than a minute, rendered her insensible without any excitement or agitation. Her countenance slightly colored, and her eyes closed; the breast was laid open by the knife freely, without the slightest sensation of pain being manifested by her. A minute afterwards she opened her eyes, seemed to come out of a gentle sleep, manifested some emotion, and said, "I am very sorry you have not done the operation." A few moments afterwards she recovered her senses entirely, saw her abscess had been opened, and she affirmed in the most formal manner that she had not felt the operation, and, indeed, had felt nothing at all.

4th. The fourth case was that of a poor young man, whose leg Velpeau amputated on account of an incurable disease of the bones of the foot. By inhalation of ether he was rendered insensible in three or four minutes. The incisions were made, the skin divided, the flesh dissected, the bones sawed, and the leg removed, two arteries tied, and, while taking up a third, the ligature embraced a filament of a nerve; he then raised his head and uttered complaints, but his cries appeared to concern something not connected with the operation. He complained of being unfortunate, and that he was born to misfortune, and had suffered enough of misfortunes in his life-time, &c. Returned to consciousness at the end of three minutes after the operation; he said he had absolutely suffered nothing; did not know that he had been operated upon, and had no remembrance of having cried or wished to move. He simply remembered that during his sleep the idea of his misfortunes returned to his mind, and had caused a more vivid emotion than usual.

5th. The fifth case was the removal of a grown-in toe-

nail from a sensitive and hysterical girl. This operation is one well known as of a most painful character, since it consists of splitting the nail in the middle, and tearing, by means of forceps, the two separated halves of it from the inflamed gland and flesh. The first effect of the ether on this girl was to bring on one of her hysterical paroxysms. The operation was not performed in this state of the patient, but after several trials she bore the ether well, and at the last trial she was rendered insensible by its inhalation for the space of two and a half minutes. The operation was then performed as above indicated. Not a movement took place nor cry escaped the patient, nor was any sign of pain manifested during the operation; nevertheless this poor girl seemed to know what Velpeau was doing, for she raised her head as he seized the toe, and M. Velpeau caused the hand of one of his assistants to be held over her eyes. Two minutes after the operation she recovered her senses, and said she had in no wise suffered, and had felt nothing of the operation. She had one of her hysterical turns of short duration afterwards.

6th. The sixth case was the removal of an eye from a very nervous and impressionable gentleman. The trial of the effects of ether were made on him at intervals some days beforehand, by which he was convinced that he could be made insensible. All being arranged for the operation, the ether was administered to the patient, and in five minutes he was under its full influence. Then the eyelids were slit open, the muscles of the eye divided, the optic nerve cut off, and the tumor was dissected out. The orbit of the eye was then filled with lint, and the dressings applied, and his face washed, and all this time the patient did not stir or utter the least cry, or manifest any sensibility or sign of pain. After completing the dressings, or two minutes afterwards, his consciousness returned. He was a cultivated and intelligent man, and was able to give

an account of his sensations, and said he had not suffered in the least, and had felt nothing; that at times he did perceive that they were drawing on something in the orbit of his eye, and that there was a noise there, but that it did not trouble him nor cause any pain. He heard Velpeau talking to his assistants, but did not know what was said. He found himself in a state of strange numbness and inaptitude for moving or talking, In short, he had a sort of nightmare during the whole operation, with painful ideas relating to his private and personal affairs.

7th. Seventh case, removal of a portion of the hand of a laboring printer for a fungous tumor complicated with cavries of the bones. Patient very excitable, very fearful of pain, and begged that he might have the benefit of "the precious discovery." He was etherized in three or four minutes. The first incisions gave him no pain, but in the latter half of the operation he began to cry and to resist, and endeavored to escape. The assistants held him, and the operation and dressings were completed. When he returned to his natural state he hastened to make excuses, and explained that his movements had no relation to the operation, but concerned a quarrel which he supposed he was having in his work-shop with his comrades, he imagining that one was holding his hands, and another his leg, to prevent his engaging in the fight. He protested that he had felt no pain, had felt nothing, although he knew that they were operating upon him.

"Such," says Velpeau, "are the principal facts which I have studied myself during the last week. I would add that a crowd of physicians and students are now submitted to the ethereal inhalations, in order better to appreciate the effects. Some of them submit themselves to it with pleasure rather than repugnance; these all arrive, more or less promptly, to a state of insensibility. Some of them, two among others, have learned by repeated exercises to

indicate all the phases of the phenomena, to say where it was proper to prick them or to pinch them; to say when they feel, and when they do not feel; and more, strange and hardly to be believed thing, they have, after losing, their tactile sensibility, preserved so well the other and intellectual faculties as to be able to prick, pinch, and even dissect themselves without causing pain or suffering at all!

"We see, then, that it can no longer be doubted that the question of inhalation of ether is about to assume proportions altogether unforeseen. The fact that it includes, is one of the most important that can be conceived; a fact, the reach of which it is already impossible to estimate, and which is of a nature to impress and move profoundly not only surgery, but also physiology, chemistry, and even psychology. See that man who hears the strokes of the knife on his person, and does not feel them! observe the other, who allows a leg or a hand to be cut off, without perceiving it, and who, during the operations on him imagines he is playing billiards, or quarrelling with his comrades! Behold a third, who remains in a state of beatitude and contentment, who finds himself very comfortable while his flesh is being mangled! Behold, at last, this young man who preserves all his intellect, sufficient, at least, to arm himself with forceps and bistouri, and to operate with the knife on his own organs! Is there not something to strike and dazzle the man of intelligence on all sides at once? something to overwhelm the imagination of the most *impassible savant?*

"There are no longer any surgical operations, however grand they may be, which may not profit from the benefits of this discovery. The operation for the stone, that operation so redoubtable and so feared, is now performed without the patient feeling it. The same is true, also, of strangulated hernia. An unhappy woman in labor with

child, cannot be delivered,—the intervention of the forceps is called for,—inhalation of ether is put in play, and the accoucheur delivers the patient without causing suffering, and without her knowing it.

"If the relaxation of the muscular system becomes generalized under the influence of ether, who cannot see what we may do with it, when we are obliged to search in the interior of the uterus for the fœtus which it is necessary to remove by art? In fact, in this operation the obstacles, the difficulties, and the dangers come almost wholly from the violent contractions of the uterus.

"From what I have seen up to the present, in a serious investigation of the facts, it results that the inhalation of ether is about to become the source of an infinite number of applications, of a fruitfulness altogether unexpected,—a mine of riches whence all the departments of medicine will without delay draw forth with full hands.

"It will be the starting-point of ideas so varied, and of a value so great in whatever point of view examined, that it seems to me necessary to move the Academy of Sciences, and to ask if the author of so valuable a discovery ought not himself soon to be an object of some attention in the midst of scientific societies?"—Page 134.

I would here add, that on motion of M. Trousseau of the French Constituent Assembly, Prince Louis Napoleon Bonaparte, then President of the French Republic, conferred upon me the Cross of the Order of the Legion of Honor, for the discovery of anæsthesia, and subsequently the Academy of Sciences awarded to me "the maximum of the Monthyon Prize for the greatest discovery in Medecine and Surgery," and to my agent, Mr. Morton, "another prize of 2,500 francs, for having introduced this method into surgical practice, in accordance with the directions of M. Jackson": "*pour avoir introduit cette méthode dans la pratique chirurgicale, d'après les indications de M. Jackson,*" an

award accepted by both parties, and one which should have put a stop to any further controversy.*

After M. Velpeau had made his statements, and had replied to the objections made by M. Magendie, M. Roux, the celebrated Surgeon of the Hotel Dieu of Paris, sustained the views of M. Velpeau by citing a number of cases in which he had operated on patients, at his hospital, under the effects of ether. He says, "During the four days past I have operated on five patients. These were as follows: On Friday, one for fistula lacrymalis, and in four cases the operations were for abscesses of considerable size in the breast, in the arm, the palm of the hand, and the sole of the foot. The opening of such abscesses, although made with considerable rapidity, is always most painful, as we have to operate on inflamed parts, the sensibility of which is more or less exalted beyond what it would be in the natural state of the parts. The woman with the abscess was willing to bravely bear the pain: endowed with that strength of mind and with that courage to bear surgical operations which I believe women possess beyond most men, she was somewhat skeptical as our colleague, M. Magendie, appears to be, and refused to try the ether. The four other patients submitted themselves to it with pleasure; all four of the patients, after some minutes of ethereal inhalation from M. Charrier's apparatus, were put to sleep. I performed the operations on all of them, without their manifesting the slightest suffering. Interrogated on their awakening as to what they had experienced, two only had a vague remembrance of a

* It is proper that the public should be put on their guard against a false statement of this award, which has been published under the name "Morton, W. T. G.," in the "New American Cyclopedia," and in a fictitious narrative, styled "Trials of a Public Benefactor," by Dr. Nathan Ricc. The statement made in these publications is untrue; and, in the award of the Academy, as stated by them, the words "d'après les indications de M. Jackson" were omitted after the word "chirurgicale." Comment on this transaction is unnecessary.

quiet sleep ; two of them had experienced pleasant dreams. The man who had the operation performed for fistula lacrymalis on the right eye, an operation in which an opening had been made in the anterior portion of the lachrymal sac, and into which it was necessary to pass a stylet and a canula ; afterwards to introduce in this canula a small elastic spring-conductor of a thread which should come out by the anterior opening of the nostril ; this man, I would say, appeared to awaken at the moment when, to terminate the operation, I was about to search for this small spring. He appeared to be agitated somewhat, and he told us afterwards that this part of the operation had produced in him a dream, in which he thought that a chemical match had been introduced into his nostril and inflamed.

"Thus four times successively, the same morning, on four individuals, who were in different conditions, the inhalation of ether vapor had all the desirable effects, and by its influence these individuals escaped the pain which would inevitably have been caused by the different operations to which they had submitted.

"Before relating, in more detail, another case, I would remark, that if the method which we hasten to appreciate with so much reason is recognized as good, and truly useful, it would be available for the less severe operations as well as for those of a more grave nature ; that is to say, those which might have eminently great dangers, and which might compromise the lives of the patients ; for among the first there are many which are as painful as those of a more grave character, and even more cruel in appearance ; many of them are really more painful. And, in general, the most apparently cruel operations are most alarming ; but it often happens that an operation is dangerous without being very painful, and other operations may be very painful and not be really dangerous. It was an operation of the latter kind this morning, which gave a very fine result

in ethereal inhalation. A young man had, in the lower part of his abdomen, numerous fistulous openings quite distant from each other, terminating with valves, and having very sinuous directions, running within the thickness of the abdominal walls at least under the considerably thickened skin, if not in the muscular interstices. This disease was accompanied by an abundant suppuration, which was exhausting the patient. I had often proposed to this young man to lay open these fistulous cavities which could not be healed by other means, and to cut away portions of the degenerated skin; always the fear of intense pain had hindered him from following this advice. Learning at length what was going on near him, and encouraged by his other companions in misfortune, he ceased to fear the approach of the instruments, and yielded with calm confidence. Three minutes only of ethereal inhalation were required to produce in him a tranquil sleep, with complete immobility of his extremities. The operation was at once performed. It was necessary to make four incisions, of considerable extent, and to cut out four flaps of skin,—in all eight distinct and protracted cuts with the knife. The patient did not flinch or make any movement, nor utter the least complaint. The operation was completed and still the sleep continued. A few drops of water dashed in his face at once awakened him, and no excitement or loquacity was manifested by him. He said he had slept soundly without dreaming, and yet part of the time he heard what M. Roux said. He remarked that he had felt no pain. M. Roux, in order to test him, said that he had but just begun the work, and that it would be necessary to repeat the operation, which, he told him, would be like what had already been done, and he at once consented to it. Great was his surprise and satisfaction when, a few moments afterwards, he was allowed to see that all had been done, and that there was

a great wound, which had been concealed from him at the moment, when this conversation took place, and he knew that the work had all been accomplished according to his wishes."

The above I have condensed from the report in the *Compte Rendu* for 1847, pages 147 to 149; session of Feb. 1st, Monday.

I have witnessed many operations, performed at the Massachusetts General Hospital, by Dr. J. C. Warren, in which the patients were greatly surprised to see that the operations had been effected without their knowing of them, or having felt any sensation of pain. Dr. Warren took much pleasure in thus surprising his patients, keeping their wounds covered until they became conscious, asking all about their experiences, and then suddenly uncovering their wounds and showing what had been done during their etherial sleep. I have also seen him apply red hot iron, and burn the skin in two zigzag lines, from the top to the bottom of the spine, the flesh burning and filling the air of the operating room with its odor, while the patient, as he alleged when he recovered his senses, had been dreaming of a very pleasant journey—had felt no pain—and he continued to talk for more than a quarter of an hour in a very intelligent manner, still having no idea that his back had been seared and roasted by actual cautery.

M. Laugier, of the Beaujon hospital, reported to the Academy of Sciences at the Session of Monday, Jan. 25th, 1847, the following case of amputation of the thigh of a girl of seventeen years of age, in which case ether was employed. He says, after she had inhaled the ether vapor for three or four minutes, she was plunged into a true extatic sleep. The amputation was then performed.

1st, Circular incision of the skin. 2d, Separation of the skin from the fibrous tissues by dissection. 3d, Section

of the muscles to the bone. 4th, Section of the deep-seated muscles adherent to the bone. 5th, Section of the periosteum and the sawing off of the bone.

Time taken for all these operations, a minute and a half. Then the arteries were tied and the dressing was commenced, when the patient became conscious, and complained of having been awakened and of finding herself among men. These were her expressions; for she said she believed herself, during her sleep, with God and his angels, whom she saw around her.

During the operation she had not manifested the slightest sign of pain, and, when asked if she had suffered, she cried out, with astonishment, "How! is it possible that my thigh has been cut off?" This exclamation was sufficient to demonstrate the fact of complete insensibility during the amputation; and the patient confirmed it by adding that she had felt nothing. Twenty persons were present at the operation, and were satisfied that this was an absolute demonstration,—the dressing being completed without any pain having been thus far manifested. After she was placed in her bed she began to feel the usual pain following such an operation. She continues to do well.—*Compte Rendu*, page 124; 1847.

Mons. Gerdy's Observations on the influence of Etherial Inhalation; experiments made on himself,—Compte Rendu, 25th Jan., 1847,—*showing that an etherized person can reason and act with intelligence, and make observations on his state.*

After overcoming the slight irritation produced by the first effects of ether, the cough being soon arrested as the organs of respiration became accustomed to the vapor, M. Gerdy says he felt a fullness and numbness of the head, with warmth and an effect on the head like that produced by alcoholic vapors. This numbness spread rapidly, first

to the feet and toes, then to the legs and at the same time to the arms, and afterwards to the loins. It increased rapidly with each respiration; it was accompanied, in the organs affected, with an agreeable sensation of warmth, and a creeping sensation, tremor, and vibration like that we perceive on touching a vibrating body, a large bell, for instance, when ringing. When these sensations came to their height the impression was obtuse, very agreeable, somewhat like intoxication, so far as he was able to judge from a comparison with the partial intoxication he had experienced from beer and new wine. The sight was not affected sensibly by this numbness, for he was able to read. Hearing was more affected, and became less and less as the intoxication progressed. Nevertheless, sounds appeared to ring in the ears, but they were not distinct when the numbness was most marked. Smell, taste, and touch were not yet paralyzed. His eyelids felt heavy, and he had a strong disposition to sleep. He resisted this in order to observe the phenomena, as the etherization progressed. He examined his sensations, paid attention to his intelligence, observed the increase of the torpor or numbness of his extremities. His intelligence was well preserved, and was quite free. His attention was active; his will firm, insomuch that he determined to walk, and did so, to observe the effects on locomotion. He noticed that the muscular organs were much affected, so that he staggered in his gait. In speaking, his pronunciation was somewhat embarassed and slow; the functions of organic life did not appear to be affected. His brother felt his pulse, and found little change from their natural state. He then repeated the experiment on eight persons, with analogous results, though not exactly alike. Some became unconscious, others were gay, and their vision was affected differently.

These experiments of M. Gerdy fully prove the facts

noticed first by me, and afterwards by M. Velpeau, that the intelligence of many persons is well retained while they are under the influence of ether, and that they are capable of making correct observations on the passing phenomena. The same phenomena have been observed in England, and Dr. John C. Warren often noticed them here in his extensive practice, and was greatly surprised at and interested in such cases.

Therefore, the doubts that some of my opponents endeavored to raise against my being able to make the observations recorded by me while under the first effects of ethereal influence, and after the full effects of the anæsthetic agent had begun to pass away, are removed and scattered to the wind.

In my own limited practice, I rarely (in accouchments) allow the woman to become unconscious. It is easy to prevent all suffering from uterine contractions, without rendering the patient unconscious; and it is a good way to teach the woman how to inhale the ether, and let her take the phial and handkerchief or sponge into her own hands, and administer the vapor to herself, as she knows best when a pain is about to come on, and can easily anticipate it by a few inhalations of ether vapor. She should, however, be watched, to see that this is not carried to excess; and it is best to withhold the ether until the pains become really of a bearing-down kind. One of my patients, who knows perfectly well how to manage the ether, described herself, when under its influence, as an "*India rubber woman, but felt that all was going on right*"; that is, she felt the uterine contractions, but did not suffer any pain from them. In the excitement from ether, she sings quite merrily, stopping now and then to inhale the ether, as she feels it necessary to meet a coming contraction.

This separation of pain from the necessary uterine contractions is the thing to be desired; and it is rarely neces-

sary (and only in instrumental cases) to render the woman unconscious; and, indeed, it is best she should preserve her intelligence, and be able thus to notify us of her condition.*

Numerous surgical operations have been performed in England on persons, who all through the surgical work on them talked intelligently, and yet said they felt no pain from the knife, which they saw dividing their flesh, and severing their limbs from their bodies.

Prof. Miller, of the Royal Infirmary in Edinburgh, reports the case of an operation performed by him, in 1847. This was on a person who had been a hard drinker of spirits, such as are always difficult to etherize.

The patient was a middle-aged Irishman,—"a navvy,"—who had sustained a compound fracture of the leg nine weeks before. The fracture had not united, in consequence of a dead piece of bone, and it became necessary to remove this by a painful operation. The patient was seated on a table, and the inhalation was applied by means of a very beautiful yet simple apparatus, made by Squire, of London, and which, we understand, had been sent to Prof. Miller by Mr. Liston,—a very suitable gift, under present circumstances, from that eminent surgeon to his own pupil. At first, little effect was produced; but after some minutes the patient fell back as if in a swoon. The operator was about to proceed; but the man immediately objected, saying he was not asleep. For full twenty minutes more the inhalation went on; the man confused and talkative, but wide awake, and occasionally expressing very emphatically that "it would not do." At length, however, while in this wakeful state, the operation was begun.

* Dr. N. C. Keep employed etherization in labor, May 5th, 1847. (See "Etherization in Childbirth," by Walter Channing, page 26.) Dr. Simpson, of Edinburgh, employed ether in labor, Jan. 19th, 1847. His first use of chloroform was on the 8th Nov., 1848. (See "Anæsthetic Midwifery," page 8; Edinburgh, 1848.)

Incisions were made on the skin and flaps were dissected off so as to expose the bone beneath. A portion of this was sawn and clipped through, and then the dead bone was removed. Only during the clipping of the bone, with strong straining pliers, did any sign of feeling escape from the patient, who was busy inhaling all the while, and now and then protesting that "it would not do."

The operation occupied about ten minutes, and from the highly sensitive nature of the parts implicated, must have been attended with excrutiating suffering under ordinary circumstances. After it was over, the professor said to his patient, "I suppose you won't let me operate to-day." "Certainly not," said the patient; "it would n't do; I must be asleep. The thing has not succeeded with me, and I am sure it can't with any one else, for I did everything I could to get asleep, for my own sake; and I 'd do anything to please you." "You won't even let me make a cut into the leg?" "No; I must be asleep; we can try it another time." This plain proof of his utter unconsciousness of the operation having been performed was acknowledged by the spectators in a hearty round of applause. The patient then sat up, and, seeing the wound, burst into an immoderate fit of laughter, saying, "No doubt there 's blood, or something very like it; but I have n't felt a single thing done to my leg. That *bates* the globe!" and on being asked decidedly as to his having felt "anything," he repeatedly answered, "Not a ha'porth." He got into amazing spirits, and refused to leave the table until he had told "all about the toldrums of the business." And then, with the manner of a tipsy man, and very happy, he kept the surgeons and students in a roar of laughter for some minutes, with a narrative of his condition during the inhalation, which, Irish-like, seemed to be a medley of imaginary fights and "killings" going on around him, but wholly irrespective of his own leg and

the operation. On being carried out, he declared triumphantly, "This is the very best thing that has ever happened in the three kingdoms." The professor stated that he considered this case quite conclusive as to the powers of ether, because there was no more painful operation in all surgery, and because the patient, having been a hard and habitual drinker of spirits, was one of those persons who are least susceptible of the ether's influence. The whole proceedings seemed to give the greatest satisfaction to the medical and surgical officers of the institution, and to a large assemblage of interested spectators.

Perhaps the most remarkable thing in such a strange tale, is the circumstance of the man's being so wide awake and talkative, all the while quite insensible to the cutting of his limb.—*Boston Daily Advertiser*, March 12th, 1857.

M. Velpeau, in his lecture delivered before the Academy of Sciences of France, on the 4th of March, 1850, on Etherization, remarks: "Never was a discovery submitted to so extensive tests (controle); never was a subject worked upon with such ardor. Experiments on animals, experiments on one's own person, experiments on healthy men, and on the sick; physicians and surgeons, all the world puts itself to the work. The fact was easy to repeat at all times and all places, and it was not long before the observations in Paris alone could be counted by thousands. Now on all sides, in every part of the civilized globe,—in Germany, in Russia, in Italy, in Spain, in Portugal, in Turkey, and in Egypt itself, as well as in America, England, and France; in the provinces and in the smallest villages, as well as in the capitals; among private persons, as in the great hospitals, etherization has become an obligatory necessity in every operation within about four years,—the number of experiments must be incalculable. So rich a harvest, a mass of materials so large, ought to enable

practitioners to examine the matter on all sides, and to separate all its elements and appreciate their importance. What singularities,—what a varied picture is unrolled before the eyes of an attentive observer! Sometimes the etherized patient is conscious of the operation going on upon him; he knows that he is the subject of it; he follows, as it were, all its phases.* A Russian nobleman, who claimed our care for a disease that could only be arrested by an operation of the most painful kind—the extirpation of a cancerous eye—was submitted to the anæsthetic vapors. The patient fell into a complete sleep, and the operation was performed without his manifesting the least sign of pain. On awakening, he explained all that had taken place with him. 'I had not lost,' said he, 'the train of my ideas; resigned to the operation, I knew that you were proceeding with it, and I followed all the steps, not that I felt the least pain; but I heard distinctly the noise of your instrument, which penetrated the parts, which it divided, and separated thus the diseased portions from those which were healthy.' Thus, minus the pain, and the faculty of moving, the intelligence remained, and was able to analyze even the operation itself.

"In others, there were dreams of various kinds, which occupied the patients,—dreams which sometimes related to the operation, and sometimes to other matters. Women have supposed themselves at a ball or a concert; some of them have spoken of visions, sometimes agreeable, and sometimes disagreeable. One of them imagined herself afloat in the air, and surrounded by a beautiful starry dome; another, that she was in a vast amphitheatre, where all the seats were filled by young virgins in dazzling white.

"A lady, who had manifested no sign of pain, while I was removing a voluminous tumor, awakened smiling, and said, 'I know it is done. Allow me to recover entirely, and I will explain all to you. . . . I have absolutely felt

nothing,' she soon added, 'but this is how I knew I had been operated upon: In my sleep I went to make a visit to a lady of my acquaintance, to speak about a poor child we were to provide for. While we were conversing, that lady said to me, "You believe yourself to be, at this moment, at my house,—is it not so? Well, my dear friend, you deceive yourself entirely; for you are at home, in your bed, where they are performing an operation on you at this moment." Far from being surprised at her language, I quietly replied, "Ah! if it is so, I beg leave to prolong a little my visit, that I may find it all over when I return to my house." And, behold! on opening my eyes, before even being awakened entirely, I was able to announce to you that I had been operated upon.'

"What an inexhaustible source, for psychology and physiology are these things, which separate mind from matter, or intelligence from body!

"In a surgical point of view, these dreams range themselves in two classes: one with movements and agitation, the others with calm stillness, without muscular reaction. A strange fact is also disclosed, extinguishing sensibility by anæsthetics ordinarily produces relaxation of the muscles: thus we early made use of etherization to facilitate the reductions of luxations and fractures. The most singular and almost incredible thing, is one I have observed several times, that the same patient, in an anæsthetic state, had the muscles of one part of the body paralyzed, while they contracted vigorously in the other parts. A patient of this city, from whom I removed a tumor of the left arm, was so occupied with political questions, that he kept continually declaiming and disputing, raising his right arm during the whole of his anæsthetic sleep, while at the same time the diseased arm was perfectly still, and without any muscular contractions.

"A well formed young man, whose shoulder I had to

reduce, presented this singular phenomenon: Seated in a chair, he did not cease to seize and press vigorously with the well feet and hand upon the table, and a neighboring post, while on the other side the luxation yielded with extreme facility, our extensions not meeting with the least muscular resistance. One would think that there was a mysterious intelligence, extinguishing muscular action, where it would prove injurious, and exaggerating it, as it were, where it could prove useful or do no harm.

"Dreams and irregular movements are much less frequent under chloroform than under ether. In general, patients who have been operated upon with chloroform, cannot, when they awaken, recall what has taken place; and often they do not dream. I have seen many, who cried out in that state, and yet when awakened had no knowledge of it. Sometimes they remember to have dreamed. A young lady of the "grand monde," a great amateur of music, sang a favorite air all the time and quite calmly, while I was removing an enormous tumor deep seated in her thigh. On awakening, she remembered her song, but she felt nothing of the surgical instruments."

M. Velpeau concludes his very interesting lecture as follows:

"The advantages of etherization have no need that we should exaggerate or embellish them. With the knowledge the public has already acquired, the surgeons will hardly be partisans, but the patients know enough to force them to make use of this method, and I fear no denial by the future, in affirming, that it is from this time an acquired fact, of which our art cannot dispossess itself. New formulas may be given, varying the agents; the methods may be simplified by the progress of science; but etherization will remain as one of the greatest benefits with which surgery has endowed the world in the middle of the nineteenth century."

CHAPTER VI.

ADMINISTRATION OF ETHER BY INHALATION.

How should the Ether be administered?

At first I made use of a towel, folded into a cone, the interior of which was saturated with ether. This was placed over the nose and mouth loosely, so as to allow the entrance of air all around it, or an opening was left in the apex of the cone. This is a very good method, when chloroform or a mixture of chloroform and ether are employed. I also made use of sponges, placed in a large, short, glass tube, or a funnel, saturated with ether. See my letter of 13th Nov., 1846, published by the French Academy of Sciences. Apparatus for inhaling having been called for, I proposed to make use of a large flask, with a tube loosely fitted to it, and reaching near to a mass of sponges, at its bottom, saturated with ether. I

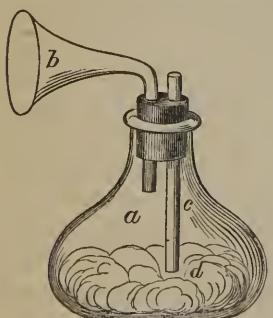


Fig. 2. The first form of Inhaler employed by me.
a. Glass flask, of three pints capacity.
b. Mouth-piece for inhalation of ether vapor.
c. Tube for admission of air and for supplying the sponges with more ether.
d. Sponges, wet with ether.
The air is drawn down the tube c, and over the sponges, wet with ether, which evaporates and mingles with the air, and is then drawn into the lungs through the tube and mouth-piece. A flap of buck-skin, attached to the rim of the mouth-piece, makes the contact over the mouth secure. The air is inhaled and exhaled through the apparatus freely.

also employed a globular glass globe receiver, with a large neck, sufficient to cover the mouth, and a tubulure for the admission of air, the globe being filled with pieces of sponge saturated with ether. To a globe of this kind, Dr. A. A. Gould applied Mawe's syringe valves, so as to prevent the exhaled air from returning to the inhaler.

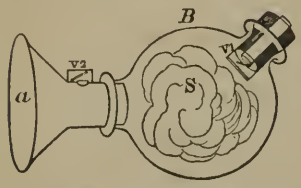


FIG. 3, Is the next Inhaler proposed by me, which subsequently had valves affixed at the suggestion of Dr. A. A. Gould,—this being the apparatus employed at the Massachusetts General Hospital. It was constructed by N. B. Chamberlain, of Boston.

a. Mouth-piece, with valve V 2., for exhalation.

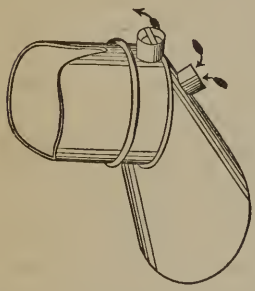
B. Glass globe, a common two quart globular condenser, used by chemists, with a valve for admission of air, V 2.

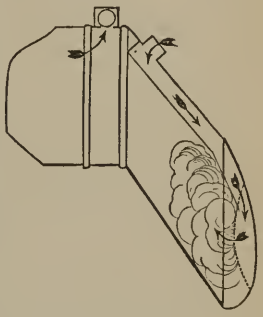
S. Sponges wet with ether. The ether is renewed, by taking out the valve seat V 1, or by removal of the mouth-piece, and some delay is caused by this; it would therefore be advisable to have another tubulure, at B, for injecting ether without the removal of the apparatus. Such a contrivance has been added by M. Charrier, of Paris.

This apparatus, so modified, was for a long time employed by the surgeons of the Massachusetts General Hospital; but it often happened that the respiratory organs were unable to move the valves, and the patients suffered from partial asphyxia, and the dark color of the blood, from wounds, led them to believe that etherization was nothing more than partial asphyxia. Some alarming cases of the kind were mentioned to me by Dr. Warren, when I proposed to have a gas-bag of oxygen ready, to overcome the difficulty; but on going to the Hospital with the oxygen, which Dr. Warren had called for, I found that the trouble arose from the stiffness of the valves of the inhaler; and when they were opened by means of a probe, the respiration went on freely,—the patient was duly etherized, and the blood had nearly its natural color, so there was no occasion to administer the gas, for there was no sign of an asphyxiated state. Soon after the inhaler was dispensed with, and a large sponge was substituted, which answered

the purpose so well that no other instrument has been employed in the Hospital practice.

Much ingenuity has been displayed, in this country, in France, England, and Prussia, in constructing inhalers for the administration of ether and chloroform. Charrier and Luer, of Paris, constructed the apparatus used in France; Robinson, that employed in England; N. B. Chamberlain, of Boston, and Isaac S. Williams, of Philadelphia, have all made good and efficient apparatus for this purpose. The





FIGURES 4 & 5. Perspective and sectional views of Dr. L. Roper's inhaler, manufactured by Isaac S. Williams, at 256 Market St., Philadelphia.

This instrument is made of planished tinned iron, and has a valve consisting of a loose marble, which is kept in place by a tin strap, and plays quite freely and easily. This valve at the orifice of the exhalation tube, is the only one in the instrument, and is not liable to become in any way obstructed. The diameter of the inhaler is three inches; its length six inches. At the bottom of the inhaler is a grating, through which the inhaled air passes, and on which the sponge rests, so that when the sponge is wet with ether, the air passes freely through it and around it, and takes up the ether in vapor, which is inhaled from the mouth of the instrument, placed directly over the nose and mouth. This instrument is by far the best that has, thus far, been invented, and saves much of the ether, while it prevents it from dropping on the person, his clothes, or the bed. It also will serve for the administration of chloroform, or for the mixture of ether and chloroform. The arrows indicate the course of the air and ether vapor, and the discharge of the exhaled air. It takes but a moment to renew the ether in this inhaler, it being poured into the opening, or a new sponge may be wet with ether, and be dropped into it, the exhausted one being removed. This instrument may easily be carried in the pocket, and it is not liable to injury, and is one with which an excited patient can do no harm.

Philadelphia instrument, having a marble for a valve, appears to me to be the most convenient of these instruments, and since it is made of tinned iron, it is not likely to be broken, or to be injured by rough usage. Dr. David

Hitchcock recommended this instrument, as very convenient for dentists, and has for twelve years made use of the one sent me by the inventor.

The objections to inhalers are as follows:

1st. It takes some time to re-charge them with ether, and thus there is an intermission in the administration, which ought to be steady and continuous, to produce the best and most prompt effect.

2d. The administration of the ether cannot be so graduated as to accustom the respiratory organs to it, by approaching or withdrawing the ether, as we do so readily, when a sponge is employed; and by evaporation the temperature is lowered so rapidly as to diminish the supply of vapor.

3d. If the valves become obstructed, or resist too much, when the respiration becomes feeble, the patient cannot cause them to open, and suffers from an inadequate supply of air.

4th. In the period of excitement, which in some individuals is very violent, and comes on suddenly and often when not expected, there is danger that harm may be done by his striking or throwing the inhaler at the surgeon or his assistants. I have known of one instance, where a large glass inhaler was broken upon a dentist's head, by his excited patient; and another, where not only the inhaler was dashed to pieces, but the dentist was driven out of his office, and his furniture and instruments were broken up, scattered or destroyed, insomuch that a bill for damages was presented to his unfortunate patient! On the whole, the sponge is preferable to all inhalers, and if complaint is made that much ether is wasted in the air, by evaporation from parts of the sponge not over the mouth and nose, and that this waste vapor fills the air of the room with its odor, we may resort to one of the bags, invented by Porta, the Italian surgeon,—the bag being made of stout silk, and

lined with bladder. In this the sponge may be placed, saturated with ether, and then the bag may be drawn loosely around the patient's nose and mouth, leaving his eyes uncovered. By this apparatus the ether is economized very much, and if there is adequate space left for the air to enter around the margin of it, no difficulty is to be apprehended from deficiency of air. The warmth of the breath, also, aids in volatilizing the ether from the sponge; whereas, if the breath did not enter the bag, the temperature of the ether would fall below the freezing point of water, by its own evaporation. The surgeons in Italy, I am informed, still make use of these bags, and it is certain that they operate very rapidly and efficiently.

Those who are desirous of seeing engravings of the different forms of apparatus, employed in the administration of ether and chloroform, will find most of them represented in M. E. F. Bouisson's *Traité de la Méthode Anesthésique*, Paris, 1850, and also in Dr. H. Chambert's *Effets des Ethers*, Paris, 1848, and in Dieffenbach's *Der Æther gegen den Schmerz*, Berlin, 1847, and in various other books published in Europe. The three wood cuts in this Manual represent the best inhalers, and include the principles of most of those which have been employed in this country and in Europe. I dispense with all inhalers, and employ the towel, handkerchief, or sponge. It is desirable to have two large sponges, of a bell shape, and they should be soaked in warm water and be squeezed out, before the ether is poured upon them. When one sponge is exhausted of its ether, let the assistant saturate the other, and hand it instantly to the operator, and take the one that has been used and rinse it out clean, in warm water, and have it ready to use again. By this method, we have clean and pure ether presented to the patient, for the water in the sponge will retain most of the alcohol, aldehydic acid, fusel oil, and other accidental impurities that are liable to

be in the ether, especially if it has not been thoroughly washed and rectified. A sponge, that has been used for inhalation purposes, soon acquires a very unpleasant smell, if it is not thoroughly rinsed out every time it is employed.

In presenting the sponge, charged with ether, to the patient for the first time, pour on only a little ether, and let him become accustomed to its vapor, before a heavy dose is placed before him; the cough generally provoked by the first impression of the ether vapor on the larynx soon ceases, and presently the patient breathes with great eagerness. If signs of wild excitement begin to show themselves, overpower the patient at once by a stronger dose of the ether, to which he will suddenly yield, and fall back as if asleep, and remain quite tranquil.

If the operation is such as to be performed while the patient is in a sitting posture, it will be found that a dentist's operating chair is the best seat for him, because he will rest easily, and cannot, in the excited state, readily rise from the chair, and the smallest force will keep him in his seat, especially if his feet but loosely touch the footboard.

The person who administers the ether should be charged with no other duty at the time, and the surgeon should have no care of that part of the operation. Two assistants are generally needed,—more are unnecessary. If, however, the operation is to be performed on a woman, another of her sex ought always to be present, both on the patient's account, and the surgeon's; for sometimes, though rarely, the patient has erotic dreams, and may, when she recovers, imagine they were founded on realities, and that would be unpleasant to all parties. I have met with only two instances of the kind alluded to: one in a young man whose tooth was to be extracted, and the other in a woman during labor; but there are cases of the

kind reported by others, in Europe and in this country. If the patient is required to be placed in a recumbent position, during a surgical operation, the head should be raised by means of a pillow placed under it, and the sponge should not be so fully charged with ether as to allow it to drip or run from it, and thereby annoy the patient, by falling into his mouth and nose; the sponge being turned over frequently by the hand, prevents the gravitation of the ether into the dependent part of it.* If, however, the sponge is large, and slightly squeezed, after being saturated with ether, there is little danger of the flowing of the liquid from it. Change the sponges, as above directed, from time to time, until the anæsthetic state is superinduced.

The person who administers the ether should be a medical man, that he may be able to judge of the symptoms exhibited by the patient. He should, if the patient is sitting, stand beside the chair, and place his left hand on the patient's head, with the thumb conveniently situated for raising the eye-lid, from time to time, for by the appearance of the eye he can best judge of the effects of the ether on the patient. In his right hand, of course, he holds the sponge near to the patient's mouth, and directs him to breathe freely, with his mouth open. A few quieting words should be spoken to the patient at first, to calm his apprehensions; and when the ether begins to take effect, the most complete silence should be observed, that the sleep should be quiet, and not agitated by the impressions conversation might give rise to, for it often happens that a train of ideas, started by conversation of persons who are present, is taken up, and strangely construed in the mind of an etherized dreamer. The assistant may feel the

* Dr. Petrie, of Liverpool, insists that a patient should never be laid on his back with his head low, when chloroform is administered, and recommends, that when practicable, he should lie on his side.

pulse from time to time, if the etherization is prolonged. The respiration is to be most carefully observed during the whole anæsthetic state, and very specially if chloroform, instead of ether, is administered. It is rare that there is any trouble from ether, but suspension of respiration, when chloroform is administered, is not uncommon, and indicates imminent danger.

The eye, under influence of etherization, at first is brilliant as from excitement, then the pupil contracts, and afterwards dilates, and the eye suddenly rolls up, and the patient is then asleep and insensible to pain. In operations of brief duration, this state is all that is desired; for instance, in the extraction of a tooth, the opening of an abscess, or any other short and sudden operation;—but if one of longer duration is to be performed, the etherization should be continued for a few minutes longer; and if luxations or fractures are to be reduced, the ether should be administered until relaxation of the muscles takes place, which may be readily ascertained by lifting up one of the arms, and then letting it go, when it will fall, as if paralyzed. This state of profound anæsthesia may be kept up by renewing the ether the moment any signs of recovery of the muscular powers are manifested. In amputations, excision of tumors, taking up of arteries, extraction of bullets, pieces of cloth and fragments of broken bones from wounds, the anæsthetic state must be carefully maintained by an attentive and intelligent person, who has charge of the process. By practice, a degree of skill in this business may be acquired, that will surprise even experienced surgeons. I taught one of my young men, who served as an assistant, to manage the administration of ether so that he could hold any patient safely in an insensible state for an hour or longer, without the least danger to life, and keep a person balanced in a painless state, while preserving his intelligence remarkably. This young gentleman

had, however, practised with ether and chloroform on his own person, to an extent I believe unparalleled in the history of the art, and would at any time, to satisfy the curiosity of a visitor, etherize himself to unconsciousness.

To the inquiry, What quantity of ether should be administered? I would say, that we judge wholly by the effect it has on the subject. The surgeon ought, however, to have at least a pint of ether on hand when he begins the process. Some require only an ounce, others four, six, or eight ounces; refractory patients often inhale as much as a pint of ether. If chloroform is employed, about a drachm is poured upon the sponge, or into a towel formed into a cone, or upon a handkerchief. If the mixture, prescribed by me for army uses,—namely, four measures of ether and one of chloroform,—is employed, about a quarter of an ounce, at one time, should be poured upon the sponge or towel, and be renewed until the proper effect results.

The effects of ether are,—first, excitement and exhilaration like intoxication; secondly, a sedative action is manifested; the pulse becomes at first rapid, and flutters; then when the full anæsthetic state results, it becomes slower, and not unfrequently falls below the normal pulse of the individual by ten beats per minute.

Chloroform depresses the pulse, and sometimes to an alarming extent. I have occasionally lowered a pulse, having a standard of eighty beats per minute, to thirty, and as the subject recovered, the pulse increased gradually to forty, and then to fifty and sixty beats per minute. He was kept insensible four hours. I never witnessed any depression of the kind from ether, nor have any alarming symptoms been observed in any of my cases.

Statistics of Surgical Operations.—I condense the following statements from the work of M. Bouisson:

"Grand operations of limbs, that is to say, amputations

of the thigh, the leg, or the arm, are generally mortal, according to Dr. Simpson, in hospital practice, in the proportions of one to two or three. In the hospitals of Paris the mortality is represented by the figures of one to two; in Glasgow the proportion was from one to two, or one to two and a half; in England, according to Dr. Simpson, one to three and a half,—while in the same hospitals, the same kinds of operations, performed on similar patients, but who had been etherized, the mortality was only twenty-three per cent., or one to four nearly.

"The following table expresses neatly the results:

DR. SIMPSON'S TABULAR STATEMENT.

Without Ether.	Operations.	Died.	Per cent.
Hospitals of Paris,—Malgaigne, .	483	273	57
Hospitals of Glasgow,—Laurie, . .	242	97	40
General collection,—Phillips, . . .	1369	487	35
English hospitals,—Simpson, . . .	618	183	29
With Ether,			
According to Dr. Simpson, ...	302	71	23

"This comparison is altogether in favor of etherization, and the demonstration is quite striking. On 100 amputations in the English hospitals, there were six saved by ether who would otherwise have died; if we take, for example, the hospital of Glasgow, the ether saved from death seventeen out of one hundred, and even thirty- four out of one hundred, in the hospitals of Paris.

"But the comparison of results of three different kinds of amputations confounded together, might leave doubts in some minds, therefore Dr. Simpson has collected a series of cases identical in nature, and the amputation of the thigh as the most frequently mortal, has been selected for comparison of cases without ether and with it. With regard to the mortality of this operation, Dr. Syme states

that 'the mean mortality is not less than sixty or seventy per cent., or more than one in two. In 987 amputations of the thigh, collected by Dr. Phillips, 435 terminated in deaths.' According to a resumé of Dr. Curling's, the amputations performed in 1837 and 1843, in the London hospitals, in134 cases of amputation of the thigh and of the leg, fifty-five died, the proportion being forty-one per cent. In the hospitals of Paris, in 201 amputations of the thigh, Malgaigne finds that 126 died. In the Edinburgh Infirmary, twenty-one out of forty-three died. In Glasgow, forty-six out of 127 died; and according to Dr. Simpson, in 284 cases of amputations of the thigh, performed in thirty hospitals in England, the mortality was 107, while in 145 amputations of the thigh under ether only 37 died.

"Hence we may say that amputation of the thigh without using ether, kills from one half to one third of the persons operated upon, while with ether the mortality is reduced to one fourth.

"The following table expresses the facts:

TABLE OF MORTALITY IN AMPUTATIONS OF THE THIGH.

Locality and Authority. Without Ether.	Operations.	Died	Prop'n of deaths per cent.
Hospitals of Paris,—Malgaigne, . .	201	126	62
Hospitals of Edinburgh,—Peacock,	43	21	49
General collection,—Phillips,. . . .	987	435	44
Hospitals of Glasgow,—Laurie, . .	127	46	36
English hospitals,—Simpson,. . . .	284	107	38
Under the influence of Ether.			
In English hospitals,—Simpson, . .	145	37	25

"The difference is much more striking than it is in the preceding table; for, in taking the mean mortality of amputations without ether, those in Glasgow, it results that etherization would have saved 11 per 100 more, who would have been cured."

M. Bouisson adds: "Such are the admirable results collected by M. Simpson. They complete the demonstration of the immense progress which surgery has made since the introduction into practice of anæsthetic inhalation.

"It is seen that it is not only in rendering operations much more easy to support, that ether ought to be accepted as a benefit, but that its influence extends even to the sequel; that it adds safety to the surgical operation, and diminishes the mortality in a proportion at once high and incontestible. It is desirable that tables of all the operations in large hospitals should be prepared similar to those which Dr. Simpson has made for amputations. We doubt not that we should thereby be presented with conclusions quite analogous for the various kinds of operations, even for those of a most grave nature. A table of this kind prepared by M. Roux, at the Hotel Dieu, has proved that when the mortality of grand operations was one third, it was reduced to one fourth by the use of ether."

M. Bouisson has begun a work of this kind in the Hospital St. Eloi, at Montpellier, and has given all the particulars of ninety-two operations, performed under ether and chloroform. It should be remarked here, that the climate of Montpellier is more salubrious than that of Paris, and of most of the localities of hospitals that have been named in the foregoing tables, and that the mortality of amputations of large limbs in the hospital at St. Eloi has been but one in eight. I think this proportion will nearly represent the mortality of similar operations in the United States; but, unfortunately, we have no statistics on the subject, though I besought most earnestly their preparation here at the time I published the discovery of etherization. We are therefore compelled to resort to the experience of the surgeons of Europe for our statistics. I do not know why we are left without statistical tables of army surgery, etherization having been extensively employed, both in

the Crimea and at Solferino and Magenta, more than 30,000 operations having been reported to the Emperor of the French, as performed under the influence of a mixture of ether and chloroform. Perhaps tabular results have been prepared; but, if so, they have never been seen by me. I merely know by letters from France, that "Ether is used in all the operations in the army, and with invariable success."

The preparation, which I directed for military use, was four measures of ether and one of pure chloroform, mixed. This was styled Ether Chloroformé, in the armies of the Crimea. I am not aware of any fatal accident having resulted from the employment of this preparation. The presence of so large a proportion of ether prevents the terribly depressing effects of the chloroform, lightens its vapor, and thus diminishes the danger from the chloroform. One of my objects was to make the anæsthetic agent so portable, that it could conveniently be carried into the field of battle; for I knew that it would be difficult to induce military surgeons to encumber themselves with quart bottles, when they could carry all they needed in phials of a few ounces capacity.

EXPLORATION OF WOUNDS.

All surgeons are more or less affected by the sufferings they have to impose on their patients, during their examinations of wounds or fractures, and in many cases fail to make such an examination as to satisfy themselves beyond a doubt, as to the real condition of the wounds or injuries they have to examine, the fear of tormenting the sufferers causing them to abstain from rough handling or exploring of the parts, and sometimes great and fatal mistakes are made in diagnosis, owing to this natural but ill-judged tenderness for their patients.

Now, since we can render patients wholly insensible to

pain, we can thoroughly explore the diseased or injured parts; actually cut into them, if the probe does not give satisfactory information, and without giving the patient the least sensation of pain. Fractured bones may be roughly handled, grated together so as to make sure of the fact of their fracture, and also discover the precise nature and extent of the injury. Similar rough handling may be done in examination of dislocations, and not unfrequently the dislocated limb may be reduced, on the very first examining of the parts, and without the aid of assistants and of pulleys. Diseased bones may be explored, by dissection, before performing the required amputation, and thus the operation may be done with greater knowledge and certainty, and the mortification of having to do the operation over again may be avoided by the surgeon, while the feelings, and, above all, the safety, of his patient is secured by his knowledge of the precise limits of the disease, so as to know where the amputation or excision should be made.

In breaking up an old callus, in badly-united fractures, ether renders the patient as passive and painless as a dead body; muscular resistance is prevented, and the work becomes simply mechanical.

In exploring wounds, searching for balls, fragments of bone, pieces of clothing carried into a wound, searching for splinters in the flesh, the removal of necrosed bone, and in hundreds of operations the military surgeon is liable to be called upon to perform, ether will prove an invaluable aid, one which, indeed, in these times, he cannot dispense with.

In reducing compound fractures, it enables him not only to prevent all suffering, but it also renders the muscles powerless, so that the fractured bones may be readily placed in apposition, and be secured there, before muscular power is allowed to reinstate itself. The reader is referred to what Messrs. Velpeau and Roux have said on

this subject, in another part of this work (p. 60 et seq.). Strangulated hernia is also in many cases capable of being overcome by the aid of a full dose of ether, so that by taxis the intestine may be returned, and an operation with the knife is avoided.

DETECTION OF SIMULATED DISEASES.

It sometimes becomes necessary for the surgeon to ascertain whether a disease is real or feigned. Tricks are sometimes played by soldiers, in order to escape from service, or to gain a pension for injuries they pretend to have received, when really they have had none. It is the duty of the surgeon to examine such cases, and by the aid of anæsthetics, he can do it in a way the impostor would not expect. If the soldier, when required to submit to this test refuses, it is reasonable to think that he is afraid of the trial, and there is a presumption that he is playing false. Thus we have known of an instance of pretended anchylosis of the knee-joint, so well feigned that the surgeon could not say, with certainty, whether it was real or not, and when the trial of the ether was proposed, though the man did not really know its effects, he was fearful, and was with great difficulty prevailed upon to allow the experiment, and only upon the assurance that if he did not do it no pension would be granted. He was etherized, and the limb was found to be quite free from the anchylosis, and was as easily flexed as the other limb. Thus the fraud was exposed. A certain degree of etherization will also serve to throw the mind so out of balance, that a contemplated deception cannot be carried out; thus simulated deafness and dumbness were at once detected by M. Bouisson, in men who were playing the game of "old soldier" upon the military surgeons. Feigned muscular contractions, with deformity produced by the will, were at once discovered, and the frauds exposed. M. Baudens

reports a case of simulated curved spine, so well acted by a soldier as to deceive the surgeons, until the ether was employed, when the crooked back at once became straight. Feigned paralysis of the hand was also readily detected by the administration of an intoxicating dose of ether, when the man cordially and firmly grasped the hand of the surgeon with his pretended paralyzed hand.

All these frauds are easily detected; but, as M. Bouisson remarks, it will not be proper to take the statements made by a person confused by ether, when drawn from him by direct and cross examinations, before and during the anæsthetic state; for we know that the intellect is very frequently thrown off its balance for the time, and utterly absurd and false statements may be made, which ought not to weigh anything in the case; but still this disturbance of the mental balance, and prevention of the employment of cunning, is proper for the discovery of the feigned disorders of the senses of sight, hearing or speech, as much so as the temporary suspension of muscular power is justifiable for the discovery of the truth as to alleged or feigned stiff joints, muscular contractions, or curved spine; for in the one case we prevent the action of a perverted will, and in the other of perverted muscular power.

IRRESPONSIBILITY OF ETHERIZED INDIVIDUALS.

No person, while under the influence of anæsthetic agents, can be held to be responsible for his actions; and since some are highly excited, in the early stages of etherization, and during the period of returning sensibility, it is prudent to watch them closely, to have sufficient force at hand to control them, and above all, not to expose near to them any weapon, which, during the intoxicated state, they might lay hold of, to inflict injury on the surgeon, his assistants, or the by-standers. The folly and injustice of bringing a legal action against a person for damages which

he did while in an etherized state, I have already alluded to, in the case in which a dentist's furniture and instruments were destroyed or injured. An instance has also been alluded to, in another part of this work, in which a dentist had a large glass inhaler dashed to pieces upon his head by a patient under the exciting effects of common alcoholic ether of commerce. The dentist in this instance, perhaps, was properly punished for administering an impure ether, not fit to be used, for the production of anæsthesia.

There are persons,—those who have been hard drinkers, —who are excited by ether in the same way they were by alcoholic drinks, and the surgeon should watch such individuals with some care, during the administration of anæsthetics.

CHAPTER VII.

INTEMPERANCE OPPOSED TO ETHER.

It was at first supposed there were more individuals incapable of being etherized than there proved to be on subsequent experience. Most of the failures were owing to imperfect apparatus, the inferior quality of the ether employed, or want of skill in its administration. Still there are some persons extremely difficult to affect by anæsthetics, and a few whose constitutions have been so hardened by the habitual and excessive use of ardent spirits, as to render them completely proof against both ether and chloroform. The best evidence that ether operates differently from spirituous drinks, is the fact that a partial intoxication obstructs and often prevents the anæsthetic effects of ether, and it is certain that habitual inebriates are the most difficult subjects to etherize.

In one instance I gave a pound of ether and a quarter of a pound of chloroform to a stout young seaman, who had just before drank a "stiff glass of brandy" to brace him against the pain of a dental operation. This enormous dose of ether and chloroform, faithfully inhaled, had no other effect upon him than to produce nausea and vomiting. His tooth was extracted, and gave him as much pain as usual in such cases. In another instance I administered a still larger dose of these two anæsthetic agents,—first the ether, and then the chloroform,—to a person who had, for the greater part of his life, made free use of ardent spirits, with frequent intoxication, and the anæsthetics

produced only nausea and wild excitement. He could not be rendered insensible to pain.

In order to impress upon men the fact that habitual inebriety renders them incapable of enjoying the benefits of etherization, while at the mines on Lake Superior I selected, from among the miners and superintendants, several individuals of the temperate and intemperate classes, and caused them to inhale ether at the same time, and in exactly the same manner. The temperate men, in from three to five minutes, were thrown into a tranquil sleep of insensibility, while the drinking men proved difficult to affect, and were mostly rendered wild, excited, and even pugnacious, so that they had to be forcibly restrained. This was a valuable temperance lesson, which was duly appreciated by the spectators of the scene.

I would recall the reader's attention to the experience of the French surgeons, and to the fact that their subjects were generally etherized in about five minutes. To me this would be ample evidence of temperate habits in the persons operated upon,—and we know that the abuse of alcoholic drinks is very rare in France, and even light wines are drunk generally in moderation. Women, who are almost always temperate, are more readily affected by anæsthetic agents than men, and children are always facile subjects. There is also a marked difference in the susceptibility of different nations, apart from temperate or intemperate habits.

Surgeons will naturally inquire what are the contra-indications which we must take into consideration in applying ether to a patient. Is chronic disease of the lungs a sufficient reason for omitting the administration of ether? Experience has proved that it is not, and that even consumptive persons bear the ether perfectly well, and have no exacerbation of their symptoms produced by it. Disease of the heart I should consider a decided contra-indication,

and a tendency to apoplexy, if marked, is also a sufficient reason for withholding the ether; but I know of no other constitutional disorders that would forbid the application of anæsthetic agents. The surgeon himself will be able to judge better than myself in the special cases which may be under his immediate observation.

Persons not accustomed to the phenomena sometimes presented by patients who inhale ether, are not unfrequently alarmed by the wild struggles and outcries which are occasionally manifested, during the period of excitement which precedes the anæsthetic state, and they desist from administering the ether, when the true and proper course is to hasten its effects as much as possible, so as to cause the patient to pass to the next stage, or that of true anæsthetic sleep. When the feet are stamped upon the floor, or struggles commence, and there are signs of excitement, pour on to the sponge a larger charge of ether, and administer the vapor as rapidly as possible. In a few moments the full effects of the anæsthetic will take place, and then no more resistance need be feared. If a capital operation is to be performed, continue the application of ether until the patient's arm, on being raised and let go, falls powerless by his side, and let the assistant keep up this state of complete anæsthesia, until the operation is completed and the dressings are applied. Sometimes nausea and vomiting take place; but so far from being injurious vomiting is beneficial, and generally occurs when the stomach is full. It often prevents headache, which would otherwise follow. There is a great difference in the susceptibility of different individuals to the influence of ether vapor, as before remarked; but most persons can be acted upon so as to be in a suitable condition for a painless operation in five minutes, if the ether is administered boldly and in large volume,—a method which is always safer than a timid administration, which is likely to excite the patient,

and is also followed by more of the unpleasant symptoms. The safety of etherization commends itself to the surgeon, while the danger of chloroformization is apt to render him anxious as to the results.

When the operation is completed, and the surgeon wishes to restore the patient to consciousness, he should sprinkle a little cold water on the face and head, or wash the face and head quickly with ice-water. This rarely fails to awake him. It should never be attempted to make the patient swallow any liquid, while in the anæsthetic state, for there is great danger of the liquid going into the trachea, the epiglottis being in a relaxed condition, and not susceptible to its usual stimuli. Ammonia applied suddenly to the nostrils is a good and proper stimulus; but it is rarely necessary to apply anything but a dash of cold water to the face. The sudden recovery from the anæsthetic state is not often required, and it generally is effected in order to make immediate inquiries as to the experience of the person operated upon. The usual course is to remove the patient from the operating table to his bed and let him sleep as long as the ether affects his system. No fatal result from ethereal inhalation has thus far taken place to my knowledge; and I believe it is the opinion of our surgeons that no death can be fairly attributed to the effects of ether. European surgeons are also of opinion that it is vastly safer than chloroform, and it is probable that, ere long, chloroform will be employed only to reinforce ether, and that mostly for army purposes, it being desirable in field practice to have an agent of less bulk than ether, but not so dangerous as chloroform. The symptoms produced by the mixture of four fifths ether and one fifth chloroform, are exactly the same as those from ether alone, and I have never seen any disagreeable or fatal accident resulting from the effects of this mixture. It is largely employed in the armies of France and of Austria.

"It is officially reported to the Emperor of the French that chloroform was used in 30,000 surgical operations in the Crimea, by skilled assistant surgeons, without a single death. A similar success has followed its administration at Solferino and at Magenta. Surely this is a practical demonstration of its use in skilful hands. In English hospitals, however, the success was less favorable, resulting, probably, from the mode of administration."

In explanation, it should be stated that the English surgeons made use of chloroform, while the French employed the mixture of four measures of ether and one measure of chloroform, in accordance with directions communicated to the Emperor and to the Academy of Sciences of France by the author of this work, previous to the Crimean expedition. This preparation is also recognized as the ether chloroformé by the Sultan in his letter to the author which accompanied his order of Turkish knighthood. M. L. Elie De Beaumont, Perpetual Secretary of the French Academy of Sciences, also declares, in his letter to the author, that the ether has been employed in the French armies in the Crimea with uniform success.*

Although chloroform may be administered without producing any alarming accident, still no one will deny that sudden deaths do take place from its effects, and that disagreeable and alarming symptoms more frequently arise from its administration than from that of ether.

Chloroform vapor is so heavy that, when administered to a recumbent patient, it is liable to drown him, from its great concentration and want of a due admixture of air. It sometimes suddenly arrests the respiration, and the patient dies before anything can be done for his recovery. It produces

* ANÆSTHETICS IN THE AUSTRIAN ARMY.—A circular has recently been issued, ordering that in future, the army medical officers shall always employ, for the purpose of inducing anæsthesia, a mixture consisting of one part chloroform and nine parts ether, these being the proportions long employed by Dr. Weiger, a Vienna dentist. (N. Y. Medical Times.)

sudden spasms and convulsions, which I have known to continue for three days, to the great alarm of the patient's friends. The treatment indicated by the sudden arrest of the respiration is obvious: namely, to produce artificially the breathing, by at once applying the mouth to that of the patient,—holding his nose and pressing back the thyroid cartilage, so as to prevent the passage of air into the æsophagus, and then blowing up the lungs by the breath. Repeat this operation until breathing is reëstablished. Do not attempt to pour any liquid down the throat, for it would assuredly go into the larynx and drown the patient. The method to be employed for resuscitation is to be the same as that employed on a drowned person, excepting that no attempt should be made to pour any stimulant into the stomach, unless by means of a stomach pump.

The convulsions arising from the effects of chloroform are best overcome by the action of morphine, as was proved by Dr. Henry Bartlett, of Roxbury, in the case of his servant girl, who had been operated upon by chloroform, and had violent spasms for some days. M. Longet, in his Experiments on Etherized Animals (p. 20), declares as a curious discovery of his, that strychnia and opiates counteract the influence of ether on the nervous system. It appears also, from the trial made by Dr. Bartlett, that morphia is an antidote to the convulsions arising from the effects of chloroform.

EUTHANASIA, OR PAINLESS DEATH.

When it was first proposed to etherize a dying person, there were many who doubted whether it was justifiable to destroy consciousness and sensibility at the moment of death. The subject was looked at from a moral and religious as well as from a medical point of view, and there are still differences of opinion in regard to it. The late

Dr. J. C. Warren considered etherization, in cases of extremely painful death, as perfectly justifiable. I would add, that there are cases in which pain may be wholly suspended or destroyed, while consciousness is entirely preserved, and that in cases where the pain was so agonizing that the mind could not act with freedom, the skillful application of ether has arrested the pain, and left the patient capable of a free use of the intellect, so that conversation was carried on by her in a rational manner with her friends, until death took place.

My friend, the late Dr. Martin Gay, who died of that terribly painful disease, acute peritonitis, by his own orders was etherized in the last hours of his life with great relief from pain, and he called for the ether as he needed it. In the case of a lady, above referred to, whom I attended, in consultation with my friend Dr. William E. Coale, the disease being acute peritonitis, with violent puerperal convulsions, following the birth of a dead and partially decomposed child (a case which we knew would soon prove fatal); by her wish and that of her friends and family physician I administered ether to her, until her death took place. Before the ether was administered, she shrieked with pain, which was of the most agonizing kind, and she demanded of me the ether. She had not the power to converse with her friends, excepting now and then to utter a hasty word amid her agony. I applied the anæsthetic agent, and in a few moments her spasms and pains ceased, and she conversed with her friends, in a most tranquil manner. Omitting for a while the administration of ether vapor, she again had violent spasms and intense pain, during which she could not converse. The ether was again applied, and she became calm as before. I kept her in a painless, but intelligent state, so long as she lived; and we all felt satisfied that this course was not only justifiable, but demanded of us by every considera-

tion of humanity. There is rarely any need of rendering a dying person unconscious, but if we should happen to pass the patient to that state, by waiting a few minutes consciousness will return again, when the ether may be repeated as required simply for the arresting of pain.

Dr. Warren has also reported a case in which he administered ether to an old lady dying of dysentery. He says, "From the first inhalation to the period of her death, five days elapsed, during which a considerable number of etherizations were used, and with such effect, that as soon as any suffering occurred, she desired ether. In the intervals, her mind was clear; she arranged such worldly matters as remained unsettled, received the consolations of religion, and finally, under etherial influence, her spirit imperceptibly took its flight." (Etherization, p. 72.)

Dr. John C. Warren, in his "Etherization, with Surgical Remarks," states, as his "general conclusions,"

"1st, Inhalation of ether produces insensibility to pain.

2d, Ethereal insensibility, judiciously effected, is not followed by dangerous consequences.

3d, Its administration is easy, and usually requires but a few minutes.

4th, Individuals of all ages may be safely etherized.

5th, Individuals of the same age are susceptible of the influence of ether in variable degrees.

6th, Surgical operations may be done under the effect of ether, which could not be done without.

7th, Operations very short, and not very painful, especially those about the head and neck, are best done without ether.

8th, The shock of the nervous system is greatly diminished by etherization.

9th, The use of ether has increased the number of successful operations, by encouraging a resort to them at an earlier period of disease.

10th, The use of the sponge is more safe and easy than that of any special apparatus.

11th, A special apparatus is convenient for some peculiar cases.

12th, The existence of chronic pulmonary disease rarely forms an objection to etherization.

13th, Etherization may be employed advantageously as a substitute for narcotics.

14th, The employment of ether does not retard the healing of wounds, nor give them an unfavorable character.

15, The pains of death may often be relieved by etherization."

In all these conclusions I most fully concur, excepting the objections to the use of ether when operating about the head and neck. Subsequent experience, I think, satisfied Dr. Warren that operations may be safely performed in the mouth and throat while the patient is in the etherial sleep,—at least his practice in the Massachusetts General Hospital seems to indicate that he had changed his opinions on this matter.

USE OF ETHER IN CASES OF INSANITY.

Ubi somnus delirium sedat bonum.—Hipp. Aph., Sec. 11, 2.

It is well known to the medical world, that long privation of sleep will produce insanity, and it is also known to the physicians of insane asylums, that if an insane patient, with suicidal tendencies, can once enjoy even a short respite from delirium by sleep, much benefit ensues, and not unfrequently the suicidal mania is removed, and sometimes the whole tenor of the delirium is so altered as to render the patient quite docile. Sleep is the first favorable sign in such cases of insanity. Knowing this, and being desirous of testing the efficiency of the artificial sleep, produced by inhalation of ether, I consulted with my friend, Dr. Luther V. Bell, the distin-

guished physician for the insane, at that time having charge of the McLean Asylum, which is the chief department of the Massachusetts General Hospital, and he at once invited me to make the trial on some very refractory patients in that institution. I therefore repaired to the Asylum, provided with the requisite anæsthetic agents,—ether and a mixture of one measure of chloroform with four measures of ether. The first patient we operated upon was a furious maniac, a powerful and muscular man, confined in the padded room, where he could do himself no injury. He had torn off all his clothes, and was quite naked. A number of Dr. Bell's assistants entered the room, and took him out into the hall, and held him extended in the air so that he could not make any effectual resistance, and I then administered ether to him, during his violent struggles, in which he spat at the sponge, tried to bite it, and in every way to prevent the administration of the vapor. He was so refractory that a pint of ether was soon exhausted, and then we made use of the mixture of chloroform and ether, which finally subdued him, and cast him into a profound snoring sleep. We then returned him to his room and placed him in a comfortable position on the floor, with a pillow under his head; an additional dose of ether was given to him subsequently, and he was kept in a state of deep sleep for many hours. When he awoke he was quite calm and rational, and continued so for months afterwards, and was finally discharged, relieved if not cured. We have heard nothing from him since.

Encouraged by the success of this experiment, we proceeded cautiously to administer ether and the mixture of ether and chloroform to other suicidal patients, who were in a constant state of vigilance, and some of whom had not slept for four nights in succession. These patients were all females, and were found to be very facile subjects for etherization. They were all of them strongly disposed to

commit suicide, and one of them evidently hoped that the means we were employing for her relief would kill her, and therefore she breathed the ether with the greatest eagerness. In four or five minutes she was thrown into a deep sleep, and was quietly laid upon her bed and the door of her room was closed, as we left her to go to another patient, an attendant being placed near to notice when she should awake, and inform us.

Then we operated on another young woman, who was also a suicidal maniac, and soon put her into a deep sleep. She was merely made to sit up in her bed, and the ether was administered until she was rendered insensible, and then she was laid gently down and left, with an attendant to watch her.

Thus we went on from one patient to another, until the whole eight, selected cases, were under this treatment. We returned to see them as they awoke,—some after only a few minutes sleep, and others, who had been in that state for an hour or half an hour,—and found that they all appeared quite cheerful, when they awoke, and seemed to have gained rest by sleep. The immediate results appeared very promising, and it was found, after observation for a day or two, that some of them were remarkably benefited, their suicidal disposition having ceased, though they were not cured, but manifested other delusions certainly of a less dangerous character.

Dr. Bell, who had charge of the Asylum, was of opinion, that the ether proved useful in all these cases, and more particularly where the rest of sleep was most urgently needed, and in those of strongly marked suicidal tendencies.

I have had no other opportunities for trial of anæsthetic agents upon the insane, but have learned from physicians of various hospitals and asylums in the United States, that they have in many instances employed etherization as a remedial and palliative agent, with marked benefit to their

patients. We cannot of course expect to cure cases of long-standing insanity, nor would I advise the employment of ether in any cases where inflammation or congestion of the brain or its membranes exist. The physician in charge of the patients can alone know which are the proper subjects for etherization; and the degree of success in the few instances I have named, is due mainly to the excellent judgment of Dr. Bell, in selecting the individuals on whom the trial of this agent could be safely and properly made.

Dr. John E. Tyler, the present Physician and Superintendant of the McLean Asylum for the Insane, in his last annual Report, says that "Ether is daily proving itself a valuable agent in the treatment of insanity."

"So far as I have learned, no accident or uncomfortable occurrence has ever resulted from a discriminating use of a pure article. The object of etherization with us, I hardly need say, is tranquilization of the nervous system,—the producing of sleep, or, if not sleep, repose,—and therefore, in various forms of mania, melancholia, and hypochondria,—of which persistent and protracted vigilance is both an attendant and feeder, and by consequent exhaustion endangers life, and when, as is often the case, all ordinary medication has proved utterly unavailing,—ether is found invaluable and effectual, causing more than a mere temporary effect of quiet and sleep, by a general soothing and curative influence on the system."

CHAPTER VIII.

PHYSIOLOGICAL EFFECTS OF ETHER.

It is not certainly known how ether produces paralysis of the nerves of sensation; but Flourens' and Longet's experiments on animals seem to indicate, that the nervous centres are the seat of its peculiar effects. When the lobes of the brain alone are affected, the memory of the operations done is said to be abolished, but there is still an organic recognition of suffering. When the medulla oblongata is affected, there is loss of power of motion as well as of sensation; and if the etherization is pushed too far, death takes place from resolution of all nervous action. Others think that the absorbed ether going into the blood, operates on the distributed nerves, in all parts of the body, and that the extremities being first affected, indicates that the terminations of the nerves are first influenced by the ether, and that it gradually extends to the nervous centres and subdues them also.

Experiments on animals, by M. Flourens, to ascertain the effects of anæsthetics on the nervous centres.

M. Flourens, the great experimental physiologist of France, has endeavored, by numerous vivisections on etherized animals, to discover the seat of each change in the sensibility of the nerves, both of sensation and of motion.

A dog, being etherized thoroughly, was taken for his first experiments. The spinal chord was laid bare, by

removal of a portion of its bony envelopes, and during this cruel operation the animal did not give the least sign of pain. The spinal marrow being laid bare, the posterior roots of the nerves (those of sensation), were pinched and cut; but the animal gave no sign of pain. Then the anterior roots (or the nerves of motion), were pinched and cut; but the muscles to which they went were not moved. The spinal marrow itself was then lacerated and cut, without producing any sign of pain or any convulsions whatever.

In another experiment, the nerves of motion only were affected, when treated in the same manner. The posterior roots were entirely insensible. More ether being administered to the dog, the nerves of motion were rendered insensible.

Similar experiments were tried on a rabbit, with the same results.

It appears, from these experiments, that the nerves of sensation are always affected before those of motion.—*Compte Rendu*, Feb. 8, 1847; p. 161.

On the 22d Feb., 1847, M. Flourens reported to the Academy his researches on the effects of ether on the medulla oblongata, the principal seat of life. From M. Flourens' previous researches, he ascertained that the point where on section of this medulla, the function of respitation was suddenly arrested, is at or near the origin of the eighth pair of nerves. The object in the present experiments was to observe the effects of ether on this organ. He etherized a dog about thirty-five minutes, or until a full anæsthetic state was produced. Then he laid bare a portion of the dorsal medulla spinalis, and also the medulla oblongata. On pricking the posterior portion of the spinal marrow, or on cutting the posterior roots of the nerves, no sensation manifested itself. When the anterior roots were pinched, there was a slight convulsive movement. More ether being administered, the anterior roots ceased to be

irritable, as was also that portion of the spinal marrow,—the animal remaining quite still. Then the medulla oblongata was pricked, and the animal uttered a cry, and there was a convulsive movement of the neck.

The experiment was repeated on another dog, with the same results. The medulla being divided at the vital point above named, all respiratory action at once ceased, and the animal suddenly died.

In other experiments nitric ether was administered. In three trials it killed the animals in one or two minutes, showing it to be a poison. Alcohol, when inhaled by the dogs, did not produce any anæsthetic effects. The animals were drunk, but did not lose either sensation or motion.

The facts which M. Flourens thinks his researches establish, are,—

1st, That the action of ether on the nervous centres, is successive and progressive.

2d, That this successive action goes first to the cerebral lobes and to the cerebellum, then to the spinal marrow, and at last to the medulla oblongata: so that the animal loses first intelligence and equilibrium, then sensation and motion, and at last, when the medulla oblongata is paralyzed, he loses his life. He adds that ether, which destroys pain, may destroy life, and that the new agent, which surgery has acquired, is at once marvellous and terrible.

On the 1st March, 1847, M. Flourens made another communication to the Academy on the action of ether on the nervous centres, in which he first repeats the results of the above quoted researches, and then adds:

"I have pushed the action of ether on the nervous centres until life was extinguished. The experiments were made on dogs. In six or seven minutes the etherization was complete. After thirty minutes inhalation, death ap-

peared imminent." He then laid bare the medulla oblongata. On touching it, there was a slight movement. Touched again, no movement took place,—the animal was dead.

Another dog was treated in the same way. The spinal marrow was laid bare, and on pinching both the posterior and anterior roots of the nerves, it was ascertained that both sensation and motion were paralyzed. The etherization was prolonged an hour. The medulla oblongata was exposed, and on being irritated, a slight convulsion followed, and the animal died.

M. Flourens then tried chloroform (this being the first time it was ever used as an anæsthetic agent), and found that it operated in the same way as ether, in the production of the anæsthetic state. The same experiments were then made on the medulla spinalis and the medulla oblongata, with similar results to those above stated. M. Flourens came to the conclusion, that there was a strong analogy between the etherized and asphyxiated states, owing to abstraction of oxygen from the blood by the anæsthetic agents.*

M. Roux, in reply to M. Flourens, expressed his doubts as to the successive effects of ether on the different parts of the cerebro-spinal axis, and declared that his experiments on man proved that all the phenomena might appear at once, and that consciousness, with capacity to understand and to reply to questions, during the etherized state, showed that the cerebral lobes were not affected as maintained by M. Flourens. He also objected that during the etherized state, the blood from the arteries and veins preserved their normal color and appearance, and thus indicated that there was no asphyxia.

* M. Flourens' Experiments on Animals, with Chloroform, were published in Compte Rendu of the Academy of Sciences, March 8th, 1847. Dr. Simpson's first trial of chloroform in labor was made November 8th, 1847. (See Anæsthetic Midwifery, page 10, published in Edinburgh in 1848.)

The experiments made by M. Velpeau, M. Gerdy, and others, confirm the opinions of M. Roux, as to the preservation of the intelligence in many cases of etherization, in which sensation of pain is wholly suspended.

The observations made by Dr. John C. Warren and myself, in numerous cases, prove that the sensation of pain may be removed without suspending the intellectual functions, and also that the blood from the arteries is not sensibly darkened in color, during the etherized state, provided an adequate supply of air is admitted into the lungs with the ether vapor.

I prize very highly the experiments made by the illustrious French physiologist, but think his conclusions, with regard to the specific effects of ether, will have to be modified, since they do not seem to be sustained by more extended experiments and observations on the human body, which now number many hundreds of thousands. Another class of medical philosophers consider the action of ether on the blood to be of a chemical nature, the abstracting of oxygen from the arterial blood, and thereby destroying for a time its power to stimulate the nerves, acting, in fact, somewhat like venous blood in the circulation. From the experiments made by M. M. Ville, and Blandin, it appears that, during the etherized state, the respiration gives forth more carbonic acid than it does in the normal condition,—and hence it would appear that the ether does abstract oxygen from the blood, itself also undergoing oxidation in the circulation. In such case the products of oxidation of ether must be formed, namely, aldehyde, acetic and carbonic acids, while the arterial blood is deprived of a portion of its oxygen, and is prevented from undergoing oxidation, by the presence of the more combustible agent, ether. I quote here M. M. Ville and Blandin's experimental researches on the effects of ether on the respiration.—*Compte Rendu*, p. 1017; 1847.

"In the course of etherization, the carbonic acid derived from respiration augments always in proportion as the sensibility becomes less, and diminishes as the effects of the ether pass off, and when the patient is recovered entirely, the respiration becomes normal.

No. of Experiments.	Carbonic Acid produced in the natural state.	Carbonic Acid prod. during the insensible state.	Proportions of Ether in the air inhaled.	Duration of the inhalation. m. s.
1	2·41	4·84	6·70	2·30
2	3·05	4·38	12·17	" "
3	2·79	3·11	12·00	4·00
4	1·36	3·32	12·68	4·00
5	2·04	4·42	14·11	2·30

"All these analyses were made with M. Regnault's new eudiometre, which is known to chemists as giving more reliable results than the former methods."

M. Chambert, in criticising these experiments of Messrs. Ville and Blandin, finds that the quantity of carbonic acid given out is always in relation to that of the volume of ether absorbed, and thinks it is merely a displacement of the carbonic acid in the blood by the ether, which replaces it, and that the effect is purely mechanical. (*Effets des Ethers*, par H. Chambert; Paris, 1848; page 74.)

Allowing that more carbonic acid is produced in the blood, by the oxidation of the absorbed ether, and that it is somewhat de-oxygenized; will this fully account for the anæsthetic effects produced? Is there not a specific action on the nerves, resulting from the contact of absorbed ether? and are not the anæsthetic phenomena more complex than has been supposed?

M. Lassaigne communicated to the Academy of Sciences of France, on the 31st of March, 1847, four analyses of blood which were taken for comparison from animals before and after etherization. The following table gives his results. (See *Compte Rendu*, p. 359; 1847.)

TABLE OF ANALYSES OF BLOOD OF DOGS BEFORE AND AFTER ETHERIZATION.

Kind of blood.	Color of blood.	Odor of blood.	Relation to the clot.	Of Serum in weight.	Water pr 1000 p	Fibrine per 1000 p.	Globules pr 1000 p.	Albumen & alkaline salts.
Venous before inhalation.	Red brown	Fade	53·5	46·5	798·72	3·62	145·27	52·39
Venous after inhalation.	Red brown	Ethereal	48·3	51·7	813·28	3·39	122·12	61·21
Arterial before inhalation.	Red, a little brownish	Fade	57·7	42·3	797	3·77	144·74	54·49
Arterial after inhalation.	Same	Ethereal	46·4	53·6	809·15	3·87	131·66	55·32

M. Chambert has also made some analyses of the blood of dogs before and after etherization, which differ from those of Lassaigne.

M. CHAMBERT'S TABULAR STATEMENT.

Kind of blood.	Color of blood.	Odor of blood.	Water per 1000 p.	Fibrine per 1000 p.	Globules per 1000 p.	Albumen & Alkaline Salts per 1000 p.
Arterial Normal from 2 dogs.	Red (Rutilant)	Fade	787·341	2·128	131.760	78·791
Arterial inhalation 42 min.	Red	Ethereal	758·604	2·128	182·731	56·587
Arterial inhalation 1 h. 10 m	Brownish red	Strongly ethereal	726·171	2·098	187·012	83·814

These results differ so much from those of Lassaigne, that no conclusions can be drawn from their comparison; but on taking the mean we have the following result for arterial blood:

	Normal.	After inhalation of Ether.
Fibrine, ...	2·940	2·990
Globules, ...	138·740	133·801
Albumen and Alkaline Salts,	66·640	65·240
Water, ...	791·561	697·969

From this it appears that the blood is little altered by the action of ether.

M. Heyfelder has analyzed the blood of two persons who had operations performed on them under ether, and found no difference between that and normal blood.

It is evident from the smell that the blood of an etherized person is charged with ether, and M. Flandin has actually obtained it from blood by distillation.

M. Lassaigne, by experiments on the barometrical column, sustained by vapor of ethereal blood, ascertained that the proportion of ether in the blood of an animal after thirty minutes inhalation, was eighty-one one thousandths of of its weight.

The first effect of ether, when inhaled, is to raise the temperature of the body, and afterwards there is a corresponding diminution of heat during the insensible state, and again the temperature rises as the patient recovers from the effects of the ether. This is probably in a great measure due to the modifications of the respiration, and not so much to the chemical effects of ether as has been imagined.

When a nerve is exposed by dissection, and ether is applied to it directly, the nerve loses its sensibility, and may be pinched or cut without any manifestation of pain by the animal; hence it was argued that ether absorbed into the blood acted on the nerves in the same manner; but we must remark this difference: The direct action of ether on an exposed nerve permanently destroys its sensibility, whereas by inhalation we only suspend it for a short time, and the system soon rallies, and no permanent or residual action remains on the nerves. Thus far we have to state that we have gained but little light on the physiological action of ether from vivisections and experiments on animals.

The microscope has given us some valuable light on the modifications of the capillary circulation by etherization. Dr. Henry C. Perkins, of Newburyport, was the first physiologist who detected these remarkable phe-

nomena, which have since been confirmed by other able microscopists. It was ascertained that ether and chloroform both have the power of causing a slackening of the circulation of the extreme vessels, and that, in high doses, the circulation of the blood globules is absolutely arrested,—while in more moderate quantities the anæsthetic causes only a wave-like motion of the globules to take place; but on suspending the inhalation, they begin again to move, and with greater rapidity than before. How far this stagnation of the circulation in the extreme vessels acts in the production of the anæsthetic state we do not know; but it appears to me to be closely connected with it. Then, by this stagnation, the extreme points of the nerves would cease to receive their supply of fresh arterial blood, and so with regard to the nervous centres, the medulla oblongata and bulb, the spinal chord, the cerebellum and cerebrum, would have their supply of fresh arterial blood suspended, and the anæsthetic state might be developed without any chemical decomposition of the blood, and the production of partial asphyxia thereby. Ether seems to modify the vitality of the blood and capillary vessels, as well as the nerves, and thus there may be a more complex physiological effect than has been imagined. My first predilections were in favor of the chemical change of the blood by the ether, and I do not know that any new light has been thrown on the subject to require the abandonment of that hypothesis. It is certain that chloroform does sometimes act chemically on the blood, and that the chlorine leaves the formyl and combines with the blood while the oxygen of the blood goes to the formyl and produces formic acid.

If ether is decomposed in the circulation, no injurious product remains fixed in the blood; for aldehyde, acetone, and all the products of the oxidation of ether, resolve themselves by the respiratory functions into carbonic acid gas

and vapor of water, and are thus readily thrown off from the system. Chlorine, on the other hand, destroys a portion of the blood, withering up the red globules, and combining permanently with the substance of the blood, so as to make that portion with which it has thus combined so much dead matter, which must be got rid of by the action of the secernent and excretory organs. In a chemical as well as a physiological point of view, then, ether is a much safer anæsthetic than chloroform, or any of the acidiferous ethers. Experience has fully sustained this view of the subject, and science appears to explain the principles involved.

ETHERIZING OF ANIMALS. OPERATION ON A COUGAR.

Ether was first applied to domestic animals in the Veterinary School of Alfort, in France, where it was employed to render horses insensible to painful operations, and to reduce to a powerless condition those which were otherwise unmanageable. It was even used to control vicious horses during the operation of shoeing them, and in all cases without the least injury to the health of the animals.

I once had occasion to apply etherization in operating on a cougar, or "South American lion," (a species of panther,) owned by Francis Alger, Esq., who wished to have his talons removed by cutting them out with the glands that produced them, so that the animal should not be able to injure his children, for the cougar was very adroit in catching any creature that passed his cage, by striking his paws through the bars, and had made dead game of several unhappy barn-door fowls that had ventured within his reach, and his claws had become really dangerous to persons who approached near to his cage. He was very ferocious, and uncommonly agile, striking with great rapidity and force. In order to etherize him we placed a strong plank between the bars of his cage, so as to confine him

in limits too narrow to allow him to turn round, and thus kept his head toward the gratings.

I then placed the sponge on an elastic rod, saturated it with ether, and presented it to his nose. He struck it away at once with his paws, but it was instantly applied again, and thus we continued until it was evident, from his state, that he would not make forcible resistance. I then passed my arm into his cage and held the sponge firmly over his nose and mouth, and I felt his pulse in his fore-arm. In a short time he was under the influence of ether, and lay down in his cage. I then drew out his paws and his hind legs also, and, with a pair of sharp cutting forceps, cut out every one of his claws, as high up as possible without maiming him. We then opened the cage and drew out his head, and examined his teeth. Mr. Alger also wished me to cut off the tusks; but I objected to the operation, as it would injure the animal too much. While talking on this matter the cougar began to recover, and we hastened to return him to his cage, which was done. Soon afterwards he was able to walk about, though evidently still under the influence of the ether; for he had no strength, staggered about, and appeared confused. A vessel of water was then placed in the cage, and he put his paws into it, and presently he began to lick his wounds. The cougar recovered, and was in no wise injured in health; but the main object of the operation failed; for the claws ultimately grew again, and I afterwards saw him with good strong talons in a Boston Menagerie.

A pound of ether was employed in this operation, but much of it was wasted, of course, in the first trials, when the animal made so active resistance.

Ether may therefore be safely employed in rendering ferocious beasts manageable, when it is necessary to remove them into new cages, to chain them, or to perform any operation upon them. Humanity also claims of us the em-

ployment of ether, when performing painful operations on our domestic animals. A mixture of ether and chloroform is most convenient for this purpose, and is more effectual than ether alone, and not so dangerous as pure chloroform.

When quadrupeds are etherized their posterior extremities become paralyzed first, and remain so after the fore extremities have recovered the power of motion. They drag their hind legs after them, as they move by their fore paws, exactly as the dogs do that are taken from the carbonic acid atmosphere of the Grotto del Cane, of Posolippo, in a partially suffocated state.

Any one who has seen a dog etherized, will at once discover the falsehood of the assertion, extensively published by a pretender to the discovery of etherization, that an etherized "dog leaped ten feet into the air and fell into a pond of water," for they will see that a dog cannot leap, nor even walk or stand, while under the influence of ether.

Rats, when they have inhaled ether or chloroform, drag their hind legs in the same way, and are incapable of running, so they may be taken up by the tail, just before they recover, and be placed in confinement. This experiment was often made by my pupils and assistants in the winters of 1846 and 1847.

Cats, when suffering from convulsive fits, are at once cured by ether, which arrests the convulsions and throws them into an insensible state.

Fishes are also readily etherized, by adding a few drops of ether or chloroform to the water, when they will soon cease to move their fins.

Sensitive plants are also affected by anæsthetic agents, and drop their petioles, just as they do when touched by the hand. This seems remarkable, since plants are not supposed to have any nervous system. (See Dr. Frederic W. Clemens' Experiments on Men, Animals and Plants; Berne, 1850.)

ETHERIZATION BY THE RECTUM.

In 1847 M. Pirogoff, of St. Petersburg, Russia, made an important discovery in etherization, namely, that a full anæsthetic state could be produced by injecting the vapor of ether into the rectum. This he effects by means of a syringe, such as is used for transfusion of blood,—the ether being drawn through a tin vessel surrounded by water heated to 120 deg. Fahr., so as to vaporize it.

A large elastic tube is introduced into the rectum, after clearing it of its contents, by an injection of warm water, and the ether vapor is thrown up into the intestine, by means of the syringe. From one and a half to two ounces of ether suffice to produce insensibility to pain, and the effect is stated to be equivalent to that brought about by inhalation of ether with air, as commonly practised, and no unpleasant consequences supervened.

This method is recommended in cases where bloody operations are to be performed in the mouth or throat, in which it is difficult to employ ether or chloroform.

M. Pirogoff intimates that he has experimented on man, as well as brute animals, but gives no cases in his communication to the Academy. An important physiological truth is enforced by his experiments, namely, that ether however introduced into the circulation, produces anæsthetic effects, and that the action of such agents is not confined to the blood circulating in the lungs, heart, and large blood-vessels. (See *Compte Rendu* for 1847, p 789.)

Table of Deaths attributed to the influence of Chloroform. Translated from "Traité de la Méthode Anesthésique," of E. F. Bouisson, *Paris*, 1850 (*p.*397–8), *by* C. T. Jackson, M D.

	Facts, Name of Surgeon, &c.	*Name and Condition of Patient.*	*Duration of Chloroformization and nature of Operation.*	*Epoch and Character of Death.*
1	M. Meggison, 1848.	Hannah Greener, age 15 years, great dread of inhalation of Chloroform.	Chloroform inhaled fr. handkerchief. Insensibility in half a minute, removal of a nail begun.	Immediate death in spite of all remedies given.
2	M. Pearson, 1848.	Mrs. Simmond, age 35 years, good health, though nervous; copious repast.	Chloroformization for some instants, after wh. some roots of teeth were extracted.	Death two minutes after commencement of inhalation.
3	A Surgeon of Hyderabad, 1848.	A young woman, having a lesion of left medius.	Inhalation of one drch. Chloroform from a handkerchief. Commenced amputation of the finger.	Immediate death.
4	Robinson, Dentist, 1848.	Walter Badger, age 23 years, had disease of heart and hypertrophia of liver.	Chloroformization from apparatus one minute. Operator absent 3-4 min. to get bottle of chlorof.	Died during absence of the operator, who attempted in vain, by various remedies, to resuscitate the patient.
5	M. Gorré, of Bologne sur Mer, 1848.	Mad'lle Stock, age 30 years, having been subject to palpitation and chlorosis. Abscess following superficial wound on thigh.	Inhalation of Chloroform less than one min. This time sufficed to produce grave symptoms, during which the purulent sac of the thigh was opened.	Immediate death.
6	M. Robert, 1848.	Daniel Schlyg, age 24 years. Thigh broken by a ball in the days of June; profound depression, physical and moral.	Inhalation of Chloroform during 3 or 4 min. Disarticulation coxo-femoral; new inhalation of Chloroform.	Death during the operation.
7	M. Malgaigne, 1848.	Wounded in June, having the neck of the humerous broken by a ball; weakened by hæmorrhage, gangrene of wound.	Chloroformization; disarticulation scapulo-humeral; new inhalation while searching for the ball.	Death during last incisions.
8	Hotel Dieu of Lyon, 1848.	Charles Desnoyers, 22 years of age. Scrotulous, had white swellings of left hand.	Chloroformization with apparatus during 5 min. Cauterization of joint.	Death on commencement of operation.
9	Roux, in the Hotel Dieu of Paris, 1848.	Woman with scirrhous breast.	Chloroformization; amputation of the breast.	Death before leaving the operating room.
10	Reported by M. J. Guérin, Bicêtre, Sept. 1848.	Man with lesion of thigh.	Chloroformization; disarticulation coxo-femor.	Death before end of operation.
11	M. Gordon Buck, New York, 1848.	Man weakened, having lesion of the heart, as proved by autopsy.	Chloroformization; excision of hæmorrhoids.	Sudden death just as operation was about to commence.
12	Case of Govan, London Lancet, 1849.	Young person.	Chloroformization; removal of in grown nail.	Immediate death.
13	M. Barrier, Lyon 1849.	A glazier, 17 years of age, scrotulous.	Inhalation of 6 to 8 grammes of Chloroform for 6 minutes, for amputation of a finger.	Convulsions, followed by death in half a min.
14	Case in Hospital of Madrid, 1849.	Child 12 years of age.	Chloroform employed before amputation of the leg.	Death during operation, with violent tetanus
15	M. Conferron, or Langres, 1849.	Mad. Labrune, age 35 years, of nervous temperament.	Submitted a year before with success to inhalation of Ether. Submitted to Chloroform for extraction of a tooth.	Death as from a thunder bolt—"mort foudroyante."

A few cases of Death which took place during or immediately after the inhalation of Chloroform, in the United States. Compiled by C. T. JACKSON, M. D., *Boston, March,* 1861.

	Authority.	*Name of Patient.*	*Nature of Anæsthetic Agent and Operation.*	*Death, &c.*
1	Coroner's Inquest. Dr. Charles H. Stedman, Med. Coroner. Autopsy by Dr. F. S. Ainsworth, Dr. C. H. Stedman, and Dr. C. T. Jackson, Feb., 1855.	Phebe Ann Morgan, of Boston, a stout, healthy young woman.—Case reported in Bost. Med. and Surg. Jour., by C. T. Jackson, M. D.	Chloroform inhaled preparatory to extraction of a tooth. Operation not performed.	Died in a few minutes before operation was begun. Stimulants and insufflation of lungs tried for resuscitation, without avail. Much chlorine and formic acid found in blood of heart, by chemical analysis.
2	Dr. Severence, Dentist, Salmon Falls, N. H.	Miss Packard, a healthy girl from Maine.	Chloroform inhaled preparatory to extraction of a tooth—the inhalation conducted by herself during the temporary absence of the dentist, and without his knowledge.	Found dead on return of the dentist, after a few minutes absence from the room.
3	Pawtucket Gazette.	Young girl, daughter of James C. Aldrich, of Pawtucket.	Chloroform inhaled by smelling of chloroform liniment, much of which was spilled in the bed near her face.	Died in half an hour. Stimulants tried for the purpose of reviving her, without avail.
4	Boston Traveller of April 8th, 1854.	Henry N. Dean, aged 21 years.	Chloroform inhaled for pleasure. Had often taken it for this purpose.	Died suddenly, in evening after inhalation.
5	Boston Papers, June 4th, 1858.	Ebenezer B. Jones, a young man in good health.	Took an ounce and a half of Chloroform in water, as a remedy for sea-sickness while on a fishing party in the bay of Boston.	Complete stupor, followed by violent convulsions and death in an hour; remedies found of no avail.
6	Dr. Alden March, of Albany, N. York. Trans. State Med. Soc. of N. Y., 1855, p. 159.	Miss Sarah Weaver, of Schoharie, N. Y., aged 18 years; in feeble state of health from long disease. Operation done at the Albany N. Y. Hospital.	Large tumor in neck, involving carotid artery and jugular vein.—Ether given first, then Chloroform, and a very grave surg'l operation was performed on her.	Sunk and died in two hours. Consulting surgeons attribute the death to loss of blood and nervous exhaustion. Probably chloroform hastened the death.
7	Dr. Davis, Dentist, of Lynn, Mass.	Mary Farley, an adult married woman.	Chloroform and ether inhaled preparatory to extraction of a tooth.	Died in seven or eight minutes. Galvanism and other means employed to revive her without effect.
8	Man in U. S. Marine Hospital, Chelsea. Dr. W. Ingalls.	Name not known to me.	Alcoholic solution of Chloroform, sometimes called Strong Chloric Ether.	Sudden death before operation.
9	Man in Mass. General Hospital, Boston Dr. J. C. Warren.	Name not now remembered by me.	Chloroform given by mistake for alcoholic solution of chloroform, inhaled from a sponge, preparatory to operation.	Immediate death in spite of free use of ammonia and other stimulants.

No. 6 is the only doubtful case in this collection. However, it is probable that the tendency to collapse and fatal result was partly due to the action of chloroform. Still, from its nature, the case might have terminated fatally even if chloroform had not been administered.

Table of Deaths attributed to the influence of Sulphuric Ether. Bouisson, *Traité de la Méthode Anesthésique, page* 394.

	Name of Surgeon, &c.	*Name and Condition of the Patient.*	*Duration of Etherization and Nature of Operation.*	*Time and Nature of Death.*
1	Case published by M. Roger Nunn.	Thomas Herbert, aged 52 years. Thin, weak, pusillanimous, with presentiment of death.	Etherized ten minutes. Operated on for Stone in the Bladder. Hæmorrhage abundant.	Death 50 hours after the operation.
2	Case by M. Robbs.	Anne Parkinson, 21 years of age. Health delicate.	Two inhalations for trial. Inhalation 10 minutes before removal of an enormous tumor of cancerous nature in the thigh. Operation long.	Considerable sinking. Death 40 hours after operation.
3	Case reported in Dublin Medical Press. M. Newman.	Albin Burfilt, aged 11 years. Weakened by a severe accident. Fracture of both thighs, with laceration of the soft parts.	Inhalation of Ether 4 minutes; taken again 3 minutes. Amputation of left thigh.	Exhaustion; delirium; Lipothymia. Death 3 hours after the operation.
4	Case by M. Roel of Madrid.	Dolorez Loper, aged 50 years. Very feeble constitution; drunken habits. Old disease.	Etherization for trial. Removal of a cancerous tumor, weighing 3 1-4 pounds, from the breast, after half an hour of inhalation.	Cold; stupor. Death 7 hours after operation.
5	Case observed at Hotel Dieu of Auxerre.	Bavarian laborer, aged 55 years. Cancer of the left breast.	Inhalation of Ether for 10 minutes from Charrier's Apparatus.	Immediate death at the commencement of the operation, with evident symptoms of Asphyxia.

We leave this table for the judgment of physicians and surgeons to decide whether we ought to regard any of the above cases as death produced by the action of ether. I am of the opinion that there are other ways of accounting for them.

M. Bouisson remarks on these cases as follows:

"In the first case the operation for stone on an exhausted subject; how frequently, in Cystotomy particularly, have we not seen death from nervous exhaustion in much less time than this when ether has not been employed.

"The second case, that of Anne Parkinson, appeared on account of particular circumstances to possess an important probatory value. It has been discussed before a tribunal, and an incompetent jury declared that the death resulted from the action of ether; but a medical judgment would consider it the result of the debility of the patient, the length of the opera-

tion, and the sequence would not sanction the decision of the coroner.

In the third case, which concerns the compound fracture of the two lower extremities, with great laceration of the muscles, the shock of such an injury with that added by the operation, evidently played a more important part as causes of death, than the superadded etherization.

The fourth case,—the removal of an enormous tumor from a woman, greatly debilitated by former disease,—gives rise to similar reflections. The ether given freely for trial half an hour before the operation, may have weakened the patient without being the cause of death.

The fifth case is evidently one of asphyxia (an accident), and has erroneously been regarded as a death from etherization."

It should be observed that an attempt was making at this time to show that accidental deaths resulted from the use of ether as well as from chloroform; and hence we can understand how such a list of cases was collected. It is a poor exhibition to set off against the deaths from chloroform. It is possible that injurious effects have been occasionally produced by the alcoholic or impure ether of commerce; for we know that alcoholic vapors affect the brain, but not a single instance has thus far been found, in which pure washed ether, administered as directed by me, and as stated in this book, ever caused death.

List of Authors, who have published works on the anæsthetic use of Ether and Chloroform, most of them being in the French and German languages, and one in Italian.

1. E. F. Bouisson, of Montpellier, France, 1 vol. 8vo., 560 pages, with several wood cuts; Paris, 1850.

2. H. Chambert, of Paris, France, 1 vol. 8vo. 260 pages; Paris, 1848.

3. C. Sédillot, of Strasbourg, France, 2 vols. 8vo., 105 and 53 pages; Paris, 1848, 1852.

4. E. Simoin, of Nancy, France, 2 vols. 8vo., 379 and 133 pages; Paris, 1849.

5. F. A. Longet, of Paris, France, 1 pamphlet 8vo., 54 pages; Paris, 1848.

6. F. & D. A., of Paris, France, 1 pamphlet 8vo., 120 pages; Paris, 1847.

7. Ch. Cousin, of Paris, France, 1 pamphlet 8vo., 24 pages; Paris, 1847.

8. Edward Robin, of Paris, France, 1 pamphlet 8vo., 40 pages; Paris, 1852.

9. H. Chally, of Paris, France, 1 pamphlet 8vo., 14 pages; Paris, 1847.

10. Castel, of Paris, France, 1 pamphlet 8vo., 15 pages; Paris.

11. Fred. Blandin, of Paris, France, 1 pamphlet 8vo., 15 pages; Paris, 1847.

12. Ch. Mayer, of Lausanne, Switzerland, 1 sheet 8vo., 8 pages; Lausanne, 1847.

13. Louis Figuier, of Paris, 1 vol. 8vo.; Paris, 1851.

14. J. Y. Simpson, of Edinburgh, 2 pamphlets 8vo., Edinburgh, 1848.

15. G. Grimelli, of Modena, Italy, 1 vol. 8vo. 190 pages; Modena, 1847.

16. J. C. Warren, of Boston, 1 vol. small 12mo., 100 pages; Boston, 1848.

17. J. C. Warren, of Boston, 1 pamphlet on chloroform, small 12mo., 66 pages; Boston, 1849.

18. Peter Parker, of Canton, China, 1 pamphlet 8vo., 23 pages; Canton, 1848.

19. Walter Channing, of Boston, 1 vol. 8vo., 400 pages; Boston, 1848.

20. Also a pamphlet of six cases of Etherization in Labor, by Walter Channing.

21. Dr. Flagg, of Philadelphia, 1 pamphlet, 1848; Phila.

22. Henry J. Bigelow, of Boston, 1 pamphlet; Boston.

Numerous papers in Medical and Surgical Journals, in this country and Europe, by Dr. G. Hayward, Dr. Bigelow, and others. Several papers by C. T. Jackson, in Boston and Southern Medical and Surgical Journals.

Dr. Channing's work on Etherization in Childbirth is the only volume of any magnitude thus far published in this country, on the use of anæsthetic agents. Dr. J. C. Warren's little book on "Etherization, with Surgical Remarks," is the only other bound volume published on this subject in the United States. It consists of 100 pages small 12mo. The volumes of the *Compte Rendu*, of the Academy of Sciences of France, from 1847 to 1850, contain many valuable reports on this subject, which have furnished many of the cases in this book.

In German mostly, and one in Latin:

23. Johan F. Diffenbach, Berlin, 228 pp. 12mo., 1 plate; Berlin, 1847.

24. Francis Orlowski, in Latin, pamphlet, 71 pp. 8vo.; Dorpati Livornum, 1848.

25. Nicolas Berende, pamphlet, 79 pp.; Breslaw, 1852.

26. Dr. Stanelli, pamphlet, 31 pages; Berlin, 1850.

27. Drs. Rap & Wirrien, pamphlet, 20 pp. & pl.; Hamburg, 1847.

28. Alex. Bauer, pamphlet, 55 pages; Prague, 1847.

29. J. C. Younken, pamphlet, 24 pages; Berlin, 1850.

30. Joseph Weiger, pamphlet, 136 pp.; Vienna, 1850.

31. Robert Von Welz, pamphlet, 28 pages, with plate; Wurzburg, 1847.

32. Dr. Heyfelder, pamphlet, 99 pages, 2 plates; Erlangen, 1847.

33. C. E. Hering, pamphlet, 90 pages, 1 plate; Leipzig, 1847.

34. Nicolas Berende, of Hanover, 126 pages; Hanover, 1850.

35. Edw. Martin, pamphlet, 50 pages; Jena, 1848.

36. A. Hammer, pamphlet, 32 pages; 1847.

37. W. L. Grenser, pamphlet, 68 pages; Leipzig, 1847.

38. Joseph Rosenfeld, pamphlet, 63 pp., 1 pl.; Pest, 1847.

39. Conrad Schenck, pamphlet, 45 pp., 1 pl.; Leipzig, 1847.

40. J. J. Jenni, pamphlet, 71 pages; Zurich, 1847.

41. V. N. Kronsir, pamphlet, 70 pp., 1 pl.; Vienna, 1847.

42. G. Wucherer, pamphlet, 40 pages; Freiburg, 1848.

43. E. Nathan, pamphlet, 50 pages; 1847.

44. Robert Ritter Welz, pamphlet, 28 pp., 1 pl.; 1847.

45. E. C. J. Von Sëibold, 4to. pamphlet, 27 pages; Gottengen, 1847.

46. F. W. Clements, 4to. pamph., 29 pages; Berne, 1850.

47. B. Kopczky, pamphlet, 43 pages; Vienna, 1847.

48. A. Martin & L. Binswanger, pamphlet, 148 pages; Leipzig, 1848.

49. J. Bergson, pamphlet, 133 pages; Berlin, 1847.

All the above-named documents are in the library of the author, and have been consulted in the preparation of this work. The list is complete, so far as known up to this time. There are numerous articles published in Medical Journals, most of which were read by me at the time of their publication, but cannot be conveniently referred to now.

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